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VOLUME X. March 25th, 1921.

臺灣植物圖譜

臺灣植物誌料

第拾巻

Icones Plantarum Formosanarum

nec non et

Contributiones ad Floram Formosanam.

or,

Icones of the Plants of Formosa, and Materials for a Flora of the Island, based on a Study of the Collections of the Botanical Survey of the Government of Formosa.

By

Bunzō Hayata, *Rigakuhakushi.*

VOLUME X.

Published by the Bureau of Productive Industries,

Government of Formosa,

TAIHOKU.

NOTICE

I. Dicotyledons—Polypetalous: Ranunculaceæ—Rosaceæ. Published September 10th, 1911.

II. 1. Conspectus of the Flora of Formosa, Saxifrageæ—Dipsaceæ.

2. New or Noteworthy Plants of Formosa. Published October 15th, 1912.

III. 1. Contributions to the Flora of Formosa, I.

2. On the Systematic Position of *Mitrastemon*, as a Genus representing a special Tribus of the Rafflesiaceæ. Published December 25th, 1913.

IV. Contributions to the Flora of Formosa, II. Published November 25th, 1914.

V. Contributions to the Flora of Formosa, III. Published November 25th, 1915.

VI. Contributions to the Flora of Formosa, IV. Published November 25th, 1916.

VII. Contributions to the Flora of Formosa, V. Published March 25th, 1918.

VIII. Contributions to the Flora of Formosa, VI. Published March 25th, 1919.

IX. Contributions to the Flora of Formosa, VII. Published March 25th, 1920.

X. 1. Contributions to the Flora of Formosa, VIII.

2. An Interpretation of GŒTHE's *Blatt*, in his "Metamorphore der Pflanzen" as an Explanation of the Principle of the Natural Classification of Plants.

3. The Natural Classification of Plants, according to the Dynamic System.

4. General Index to the Series, from the First Volume to the Tenth, and also to the Studies published by the Author, while he was preparing this Work on Icones.

ICONES PLANTARUM FORMOSANARUM

NEC NON ET

CONTRIBUTIONES AD FLORAM FORMOSANAM

X

AUCTORE

Bunzō Hayata

TO HIS EXCELLENCY BARON KENJIRO DEN,

GOVERNOR GENERAL OF FORMOSA.

SIR,

I have the honour to submit to your Excellency the tenth volume of the Icones Plantarum Formosanarum, nec non et Contributiones ad Floram Formosanam by Bunzō Hayata, D. Sc.

HIROSHI SHIMOMURA,

CIVIL GOVERNOR OF FORMOSA.

September 1, 1920, Taihoku.

CONTENTS.

INTRODUCTION.

The present volume is the tenth of the series, and the date of its publication is the tenth anniversary of the inception of the work which the series describes. It seems, therefore, that a few words as to the nature of the whole work and of the results obtained in the course of it, may not be out of place. The original plan, as explained in the introduction to the first volume, was to publish in a long series, extending it might be over as many as fifteen years, a flora which should contain full descriptions of all plants found in Formosa. That plan, however, was slightly altered even in the first volume, owing to the necessity of limiting in advance the number of pages so as not to exceed the grant made by the Government. That first portion of the work contains an enumeration of plants, with descriptions of new or noteworthy plants, references to species (as far as accessible), and a key to the families, genera and species with their respective localities and geographical distributions. It had been my intention to pursue this altered plan in the case of the second volume; but owing to a further reduction of the grant, I was compelled to cut out neary all references to species. Descriptions were given only in the case of plants which were new or of which I had not found adequate descriptions. Thus, in the first snd second volumes, I treated all Formosan plants, so far as known to us up to that time, belonging to families from the Ranunculaceæ to the Dipsaceæ. In the third volume, it was my desire to treat the remaining families so as to complete the flora in the rather compact form of a conspectus. But, then the new materials with which I had been loaded down since 1910, and especially two collections made by myself in my two excursions to the island (in 1912) had become so numerous that it had required my whole time to work up even the first part of them, and that had compelled me to put off, for some years, the continuation of the conspectus which made up the first and second volumes. The third and following volumes were, therefore, devoted almost exclusively to the results of studies of the materials which had been worked up since 1911. These were given continuously under the heading, "Contributions to the Flora of Formosa, I. II. etc."

The present volume gives the last part of the contributions and contains studies on species and varieties ranging from the Violaceæ down to the Polypodiaceæ. All the species of phanerogamous plants are here arranged, as in the preceding volumes, after the system of BENTHAM and HOOKER, while those

of the vascular cryptogams are arranged after that of ENGLER and PRANTL. Of the species and varieties mentioned in this volume, forty-five are proposed as new species and one is regarded as a new variety of a known species. One new genus, *Diplocarex*, has been proposed, and one family, Connaraceæ, and twelve genera are mentioned as new to the flora of Formosa. The latter genera are as follows:— *Rourea, Caucalis, Sium, Conioselinum, Bœrlagiodendron, Amitostigma, Phyllomphax, Erythrodes, Thrixspermum, Ascocentrum, Holcoglossum, Trichoglottis.* Thus, up to the present date, the flora of Formosa represents, so far as is known, 3,658 species and 79 varieties, belonging to 1,197 genera and 170 families.

The original plan of the work, as above stated, was that it should be completed in fifteen volumes, and I still intend, if circumstances permit, to publish five more volumes, issuing one each year. The completion of the study of the flora of Formosa, which is the real aim of this work, is something one cannot expect to accomplish even in a much longer time. For the present one can only hope that nothing will happen to interfere with the completion of the work as originally planned. For this all things seem to promise well. On the other hand there is always the possibility of a change in one's personal circumstances, and it would be unfortunate if this work on which I have been engaged for a score of years should for any reason come to an abrupt end and be left without having been given even a tentative form of completion. Such considerations have led me to think that I should avail myself of the opportunity presented by the publication of Volume X. to give to it something of the formal character of a concluding number of the series. I should then be quite satisfied to think that the work had been formally completed, even should the continuation of the latter part unfortunately be interrupted.

Accordingly, Volume X. contains a general index to the series, from the first volume to the tenth, and also to the studies which I published while I was preparing this work on Icones. I have also added two papers, namely:— "An interpretation of GOETHE's *Blatt* in his 'Metamorphose der Pflanzen', as an Explanation of the Principle of Natural Classification" and "The Natural Classification of Plants, according to the Dynamic System". The latter deals especially with the natural system established upon the principle on which, since my return from Tonkin in 1917, I have been reflecting, and refers generally to the explanation of natural classification to which my attention was

drawn during the score of years that I devoted to the study of the flora of Formosa. My readers will, I hope, accept the latter paper as my concluding remarks on the flora of that island and also on systematic botany generally.

Here I desire to add just a few lines of a more personal nature. In the spring of this year, it was recognized by the Imperial Academy that, since 1900, I had been devoting myself to the study of the flora of Formosa, and by the same Academy I was awarded the Prince KATSURA Commemoration Prize, principally for the merit of the volumes on Icones Plantarum, then published, being the first eight volumes of the series. In the Academy's ·rmal statement of the reasons for the award, a résume of my work was ·en. I trust I may be pardoned if I take the liberty of quoting the statement herein as my formal remarks upon the series.

An abstract of the reasons submitted for the award of the Prince KATSURA Commemoration Prize to BUNZO HAYATA, D. Sc. for his studies on the flora of Formosa.*

Many years have passed since Dr. HAYATA first undertook the study of the flora of Formosa. ·first visit to the island was made in 1900 and since then he has gone there many times the collection of materials and for the examination of vegetation. When he was still a student in the College of Science, he published several papers relating to the flora of that island. Later, in the course of his studies in the University Hall, he wrote "Enumeratio Plantarum Formosanarum" in conjunction with Prof. J. MATSUMURA, and later "Flora Montana Formosæ" and "Materials for a flora of Formosa." During that period, he frequently contributed papers on the ·me subject to various periodicals in England, France and Germany. All these articles may regarded as publications preparatory to the present work on Icones Plantarum, the merit of ·hich is the principal reason for awarding him the Prize.

The first volume of the work appeared in 1911, and since then he has continued the publication, until now the eighth volume has been issued. In these volumes, he has mentioned as many as 3458 species, 74 varieties, 1174 genera and 169 families,† of which he has described more than 1200 species and four genera that are new to science. Of many discoveries mentioned ·he work, his new genus *Taiwania* of the Coniferæ is to be regarded as the most interesting; ·he plant standing as it does a relic of an ancient flora. Since his discovery, not a few western botanists have come to the island to see this interesting Conifer.

Now, the island of Formosa lying directly under the Tropic of Cancer, and possessing many mountain ranges culminating in a peak more than ten thousand feet above the level of the sea, presents almost every kind of climatal and topographical features. Consequently, it is not difficult to imagine how extraordinarily rich must be its flora composed, as it is, of many tropical, temperate and even alpine, elements. This has long since attracted the attention of western botanists and has led them to undertake the exploration of the island. But, the climatic and sanitary conditions were so very bad there and the head-hunters in the interior still so active that it was impossible to make a thorough study of this interesting flora. Although Formosa had been explored by English botanists, before the acquisition of the island by Japan, such exploration was limited to its coastal regions. In his "List of Plants from Formosa," Dr. A. HENRY, who is well-known for his travels through China, gives but 1446 species. As the result of Dr. HAYATA's indefatigable and successful efforts, more than 2000 species have been added to that number. It may, therefore, be well said that Formosa, which was formerly regarded as

* Published by the authority of the Imperial Academy, in the Official Gazette of 10th, May, 1920.

† Now (in 1920) 3,658 species, 79 varietess, 1197 genera, and 170 families.

terra incognita by western naturalists has now been brought within the limits of *terra cognita* through Dr. HAYATA's investigations.

In accordance with the facts above stated and with the authority vested in it, the Imperial Academy hereby recognizes that Dr. HAYATA has made a great contribution to science and to the known natural resources of Japan through the study which for a score of years he has made of the flora of Formosa.

The above statement put forth by the Imperial Academy is really too much for me to accept for myself alone; for I cannot forget that it is due to the assistance rendered to me by all who have sympathized with me and been interested in my work that I have been able to make any contribution at all either to science or to my nation. As I now issue this tenth volume somewhat in the form of a conclusion to the series, I desire to acknowledge the help so kindly given to me by so many — teachers, relatives, friends and others — who, one and all, have helped forward the work which has brought me the honour of being awarded the Prince KATSURA Commemoration Prize. To them are due my most heartfelt thanks of which I beg them to accept this expression. To one unknown friend I owe the following letter by which I am profoundly touched. He wrote: "I shall take it for granted that you have no reason to accept a word of congratulation from a humble fellow whose name has probably slipped from your memory. For my part, however, nothing would gratify me so much as to have you know that there is a poor creature who under his humble roof rejoices at your success." Who the writer may be I do not know, but somehow the letter recalls my mother who is at rest, and it is hard to restrain the tears.

In token of my gratitude to all my friends, I have decided to give the whole sum which accompanies the Prize (¥en 1,000) for the promotion of science, one half to the Tōkyō Botanical Society and the other half to the Formosan Natural History Society.

In conclusion, I avail myself of this opportunity to tender my hearty thanks to the officials of the Government of Formosa, to whom I am much indebted for help in the collection of material and in the publication of this work.

BUNZŌ HAYATA.

October, 1920, Taihoku and Tōkyō.

Contributions to the Flora of Formosa.

VIII.

Violaceæ.

Viola Linn.

Viola acutilabella Hayata sp. nov. Caulis brevissimus 5 mm. longus dense foliatus stolonifer. Folia secus caulem dense disposita longe petiolata cordata 1 cm. longa totiusque lata apice obtusissima basi cordata margine crenulata supra plus subtus minus hirsuta, petiolis 2–3 cm. longis hirsutis, stipulis triangulari-lanceolatis vel linearibus 5 mm. longis 1 mm. latis apice acuminatis margine laceratis, laciniis deorsum reflexis. Scapi axillares vel terminales 5 cm. longi medio bracteis duabus instructi glabri, bracteis linearibus 5 mm. longis $\frac{2}{3}$ mm. latis apice acuminatis margine serrulis remotissime instructis hirsutis. Flores solitarii terminales. Sepala 5 plus minus inæqualia lanceolata 6 mm. longa $1\frac{1}{2}$ mm. lata apice obtusa basi peltatim affixa margine ciliolata 3–nervia. Petala 5 inæqualia glabra: labellum elongato-ovatum 6 mm. longum 3 mm. latum apice acutum basi plus minus attenuatum brevissime calcaratum, calcare gibbiformi 2 mm. lato $1\frac{1}{2}$ mm. longo; petalis lateralibus inferioribus oblique spathulatis 1 cm. longis $3\frac{1}{2}$ mm. latis apice truncatis basi attenuatis; petalis lateralibus superioribus latioribus obovatis 1 cm. longis 5 mm. latis apice rotundatis basi attenuatis. Stamina 5, filamentis brevissimis $\frac{1}{4}$ mm. longis $\frac{1}{3}$ mm. latis glabris, antheris margine dense ciliolatis oblongis $1\frac{1}{2}$ mm. longis 1 mm. latis apice appendiculatis, appendiculis triangularibus 1 mm. longis $\frac{2}{3}$ mm. latis apice obtusis; antheris 2–inferioribus dorso appendiculatis rostriformibus deorsum productis. Ovarium oblique obconicum 1 mm. longum et latum glabrum; stylo columniformi 2 mm. longo basi tortuoso-recurvo flexuoso apice sursum dilatato ad summum truncato.

Hab. Sōseikyaku, leg. B. Hayata, Mai. 1916; Monte Bonbon, leg. B. Hayata et S. Sasaki, Mai. 1917.

Viola Matsudai Hayata sp. nov. Caulis brevissimus stolonifer, stoloni-

bus longe repentibus. Folia secus caulem brevissimum 1 cm. longum dense disposita longe petiolata triangulari-ovata 2 cm. longa 22 mm. lata apice acuta ad summum obtusa basi cordata vel sinuata vel sagittato-cordata margine serrulato-crenulata supra parce subtus densiuscule hirsuta, petiolis longissimis 3–5 cm. longis dense hirsutis, stipulis lanceolatis 7–8 mm. longis 2 mm. latis apice acuminatis glabris basi dilatatis margine remote serrulatis, serrulis linearibus 1 mm. longis deorsum reflexis. Scapi axillares vel terminales 4–5 cm. longi haud bracteati vel interdum sursum bracteis duabus instructi, bracteis alternis lineari-lanceolatis 6 mm. longis 1½ mm. latis apice acuminatis margine laciniis 2–3 instructis. Flores terminales solitarii 1 cm. longi cernui. Sepala 5 oblique lanceolata 5–6 mm. longa 2 mm. lata apice acuminata basi peltata, partibus infra insertionem 1 mm. longis, plus minus inæqualia subglabra. Petala 5 inæqualia : labellum spathulatum 13 mm. longum 6 mm. latum apice truncatum medio emarginatum basi angustatum calcaratum, calcare lineari 4 mm. longo 2 mm. lato recto; petalis lateralibus inferioribus angustioribus spathulatis 13 mm. longis 4 mm. latis apice truncatis, lateralibus superioribus latioribus 5–6 mm. latis basi attenuatis. Stamina 5, antheris sessilibus oblongis 1½ mm. longis 1 mm. latis introrsis apice appendiculatis, appendiculis triangulari-rotundatis 1 mm. longis et latis glabris 2–inferioribus dorso calcaratis, calcaribus linearibus. Ovarium elongato-conicum 2 mm. longum 1 mm. latum apice obtusum glabrum, stylo columnari 1½ mm. longo glabro basi recurvato-tortuoso apice clavato-dilatato tenuiter 2–lobato.

HAB. Buizan, leg. Y. MATSUDA, Dec. 1918.

Meliaceæ.

Chisocheton BLUME.

Chisocheton erythrocarpa HAYATA et KANEHIRA sp. nov. Arbor; truncus 50 cm. in diametro. Folia alterna paripinnata in ambitu linearia vel oblonga 40–50 cm. longa 20 cm. lata, pinnis oppositis 7–9–jugis inferioribus valde minoribus, superioribus majoribus 14 cm longis 5 cm. latis apice acuminatis ad summum obtusis lineari-oblongis basi obliquissimis subsessilibus, latere superiore 3 cm. lato, latere inferiore 2 cm. lato margine integro, utraque pagine glabris,

subtus ad costas tenuissime hirsutis, costis supra impressis subtus elevatis, venis venulis utraque pagine elevatis, interjugis 4–5 cm. longis, petiolis 10 cm. longis. Flores ignoti. Fructus purpurascentes paniculatim dispositi globosi 5 cm. in diametro capsulares (loculicide dehiscentes?), pericarpiis crustaceis crassis, 3-loculares, loculis 1-spermis. Semina valde depressa rotundata pulviniformia 2½ cm. in diametro 1½ cm. alta, cicatricibus basilaribus rotundatis 2½ cm. in diametro.

HAB. Kōtōshō, leg. R. KANEHIRA et S. SASAKI, Juni. 1918.

Near *Chisocheton tetrapetalus* C. DC.

Connaraceæ.

Rourea AUBL.

Rourea volubilis (BLANCO) MERR. Philip. Journ. Sci. I. (s), p. 61; IV (c), p. 125; VI (c), p. 205; VIII (c), p. 372.

HAB. Kōtōshō, leg. R. KANEHIRA et S. SASAKI. Juni. 1918.

Leguminosæ

Entada ADANS.

Entada formosana KANEHIRA Formosan Trees p. 195.

Entada phaseoloides (L.) MERRILL; in Philip. Journ. Sci. IX. c. p. 86; KANEHIRA Formosan Trees p. 194.

Entada scandens HAYATA in Gen. Ind. p. 20, (non BENTH).

Entada koshunensis HAYATA et KANEHIRA sp. nov. (Fig. 1). Caulis scandentissimus. Rami glabri, corticibus fuscentibus longitudinaliter fissis et solutis. Folia alterna coriacea bipinnata in ambitu fere rotundata 20 cm. longa totiusque lata, pinnis oppositis paripinnatis in ambitu obovatis 8–9 cm. longis totiusque latis, pinnulis 3-jugis inferioribus minoribus, superioribus majoribus oblique ovatis 5–7 cm. longis 2–3½ cm. latis apice obtusissimis retusis basi obtusis integris utraque pagine glabris supra nitidis subtus opacis pallidis, costis supra haud subtus prominente elevatis, venis utraque pagine tenuiter elevatis gracilibus, petiolulis pinnularum 3–4 mm. longis, interjugis pinnularum 10–12

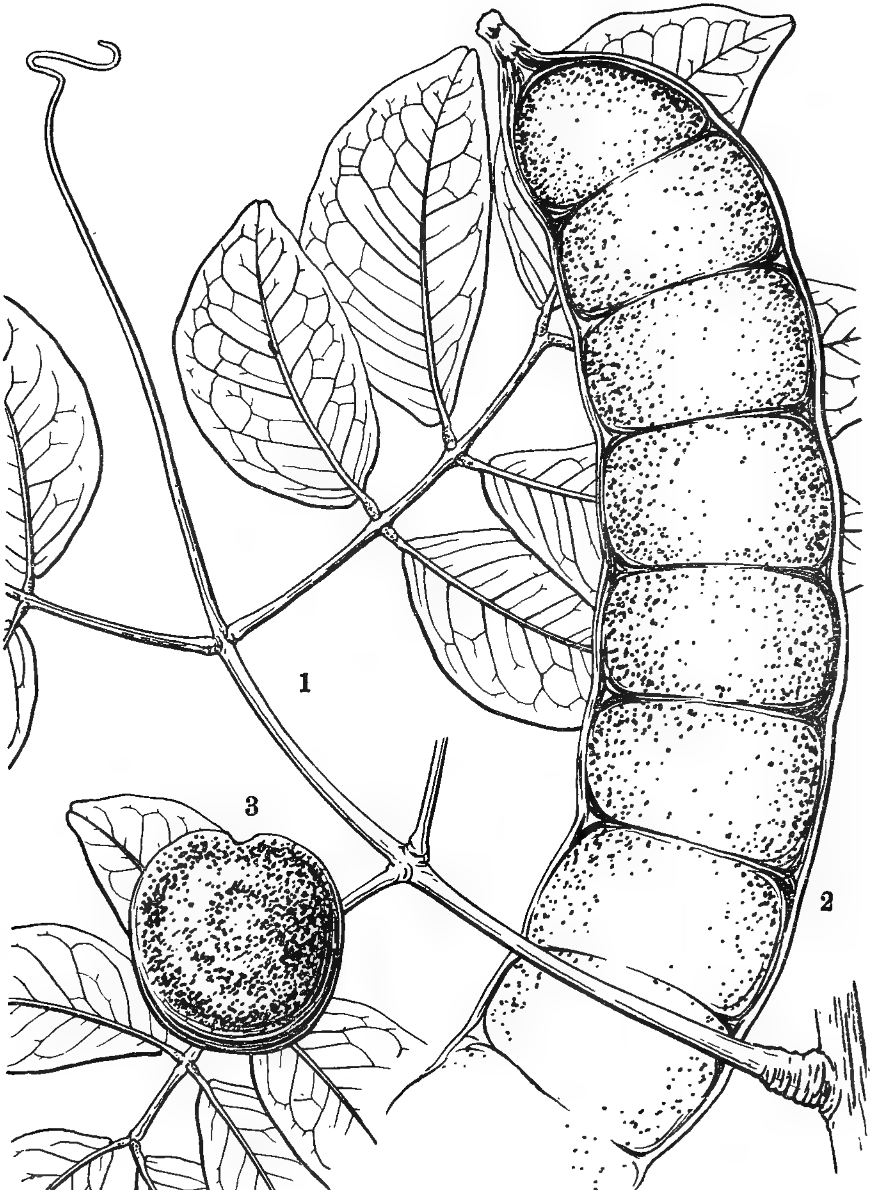

Fig. 1, *Entada koshunensis* HAYATA et KANEHIRA; 1, a leaf, natural size; 2, a pod $\times\frac{1}{2}$; 3, a seed $\times\frac{1}{2}$.

mm. longis; petiolulis pinnarum 2–3 cm. longis glabris basi incrassatis, partibus incrassatis 6 mm. longis; interjugis pinnarum 3–4 cm. longis, rhachibus ultra jugas productis, partibus rhachis ultra jugam productis 5–10 cm. longis cirrhiformibus, petiolis 5–7 cm. longis basi incrassatis, partibus incrassatis 1 cm. longis. Legumen lineare 30 cm. longum 7 cm. latum arcuatum ad suturam validissime costatum valde complanatum, loculis 7 cm. latis 4 cm. longis, inter loculos sulcatum; pericarpio coriaceo-crustaceo. Semina complanata irregulari-rotundata 3½ cm. longa et lata nitida fusco-purpurascentia, testa crustacea crassa.

HAB. Kōshūn: Kaupan, leg. R. KANEHIRA, Dec. 1918.

Ormosia JACK.

Ormosia formosana KANEHIRA Formosan Trees p. 205.

Cucurbitaceæ.

Thladiantha BUNGE.

Thladiantha punctata HAYATA (Fig. 2.). Mater. Fl. Formos. p. 119.

Descriptio aucta: Fructus globosus 5–6 cm. in diametro glaber. Semina globoso-ovoidea plus minus apiculata glabra, testa crustacea, exalbuminosa; cotyledonibus crassissimis.

HAB. Randaisan, leg. U. MORI, Aug. 1908.

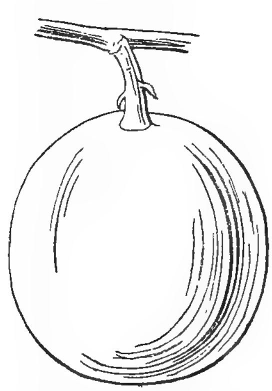

Fig. 2, *Thladiantha punctata* HAYATA.

Gynostemma BLUME.

Gynostemma pedata BLUME var. **trifoliata** HAYATA n. v. (Fig. 3). Herba tenuis; caulis scandentissimus parce hirsutus multi-sulcatus flexuosus. Folia alterna trifoliata, foliolo terminali lanceolato 8–10 cm. longo 2½–3½ cm. lato apice acuminato basi cuneato membranaceo margine

Fig. 3, *Gynostemma pedata* Blume var. *trifoliata* Hayata; 1, a branch; 2, a flower; 3, the same, seen from back; 4, stamens.

serrato, serris acutis aristatis, aristis 1 mm. longis, supra ad venas hirsuto cæterum glabro, costis venisque distincte elevatis tenuissimis subtus elevatis densissime hirsutis, petiolulis 1 cm. longis; foliolis lateralibus ovato-lanceolatis 5-6 cm. longis 2 cm. latis apice acuminatis basi obtusis, petiolulis 4 mm. longis, petiolis 2 cm. longis fusco-hirsutis, cirrhis axillaribus simplicibus. Panicula axillaris 10-15 cm. longa 7-8 cm. lata profuse ramosa hirsuta, bracteis minutis linearibus $1\frac{1}{2}$ mm. longis, pedicellis hirsutis apice articulatis supra articulationem glabris. Fl. ♂: sepala 5 linearia $1\frac{1}{2}$ mm. longa $\frac{1}{3}$ mm. lata apice obtusa; petala 5 supra minutissime hirsuta subtus glabra rotato-patentia oblongo-lanceolata 3 mm. longa 1 mm. lata apice acuminata margine serrulata; stamina 5 subsessilia ad centrum floris connata. Bacca globosa 5-6 mm. in diametro. Semina angulata 3 mm. longa et lata, testa coriacea.

HAB. Arisan: inter Keitao et Goshōrin, leg. B. HAYATA, ad 4000-6000 ped. alt., Aprili. 1916.

Differs from the type in having 3-foliate leaves which are brown hairy on the costa on the under-side.

NOTE: Flowers pale yellow-green. Leaves dark-green, not very shining.

Trichosanthes LINN.

Trichosanthes formosana HAYATA sp. nov. Scandentissima; caulis teres multi-sulcatus breve hirsutus. Folia alterna chartaceo-membranacea elongato-triangulari-cordata 6-10 cm. longa 6-8 cm. lata apice acuminata basi cordata in circumscriptione 3-lobata vel elobata, lobis basilaribus auriculiformibus, margine subintegra leviter dentata vel remote mucronibus instructa supra parce subtus dense brevissime hirsuta. Racemi floris masculini axillares cum pedunculis 10-15 cm. longi, pedunculis 5 cm. longis axillaribus solitariis; rhachis racemi flexuosa, bracteis oblanceolatis 5-10 mm. longis; pedicellis florum 1 cm. longis. Calycis tubus longissime tubuliformis 12 cm. longus apice 1 cm. latus subglaber; lobis 5 linearibus 1 cm. longis $\frac{1}{2}$-1 mm. latis acuminatis; petalis 5 lanceolatis $1\frac{1}{2}$ cm. longis 7 mm. latis 5-nerviis, nervis parallelis, apice acuminatis margine fimbriatis; columna staminalis late cylindrica 4 mm. longa 3 mm. lata, antheris sigmoideo-recurvatis, connectivis haud productis secus antheras hirsutis. Flores ♀ ignoti. Fructus globosus 5-6 cm. longus

apice apiculatus, stipite valido 1–2 cm. longo.

Trichosanthes cucumeroides HAYATA Gen. Ind. p. 31. (non MAX.)

HAB. Sankakuyū, Sōzan, Kinpori, Taihoku; Urai, leg. Y. MATSUDA, No. 267 typus!

Very near *T. cucumeroides*, but differs from it in the ovate acuminate leaves which are not lobed. In *T. cucumeroides* the leaves are usually deeply lobed.

Trichosanthes hainanensis HAYATA sp. nov. Scandentissima; caulis hirsutus multi-sulcatus. Folia alterna membranacea in ambitu cordata 5–6 cm. longa 4–7 cm. lata 5–lobata, inter lobos late sinuata, lobo terminali 4–5 cm. longo 1.5–2 cm. lato lanceolato sursum obtuso apice arista 2 mm. longa terminato ;basi plus minus constricto margine remote mucronibus instructo; lobis basilaribus auriculiformibus; 5-nervia, petiolis 1–2 cm. longis hirsutis, cirrhis axillaribus 2–fidis. Flores ♀: axillares solitarii pedunculati., pedunculis 7–8 mm. longis hirsutis. Ovarium inferum oblongum 8 mm. longum 3 mm. latum hirstum. Calycis tubus longissime infundibuliformis 5–6 cm. longus apice 4–5 mm. latus glaber; lobis triangulari-ovatis 3½ mm. longis 1½ mm. latis apice acuminatis margine integris minute ciliolatis basi dilatatis. Petala 5 lanceolata 13 mm. longa 4 mm. lata apice acuminata basi plus minus contracta margine inferiore minus superiore plus fimbriata, fimbriis filiformibus laciniatis 1 cm. longis. Stylus longe columniformis 5 cm. longus inclusus sursum 3–fidus, segmentis 1 cm. longis ½ mm. latis recurvatis glabris.

HAB. Hainan, leg. Z. KATSUMADA, Juli. 1908.

Near *T. cucumerina* LINN.

Trichosanthes homophylla HAYATA sp. nov. (Fig. 4 et 5). Scandentissima; caulis scaberrimus hirsutus multi-sulcatus. Folia alterna elongato-cordata 7–9 cm. longa 4½ cm. –7 cm. lata apice acuminata vel triangulari-acuta ad centrum arista 1–2 mm. longa instructa basi cordato-sinuata 3–5–nervia supra scabra subtus hirsuta, petiolis 2–3 cm. longis hirsutis, cirrhis axillaribus 3–fidis. Racemi axillares 9–8 cm. longi solitarii, bracteis obovatis 1 cm. longis 7 mm. latis apice acutis basi contractis utraque hirsutis margine grosse dentatis; pedicellis 3 mm. longis hirsutis; calycis tubus 2 cm. longus 8 mm. latus hirsutus, lobis 5 linearibus 5–6 mm. longis basi 2 mm. latis apice acuminatis basi dilatatis intus glabris extus hirsutis; petalis 5 obovatis 1 cm. longis totiusque latis apice in ambitu truncatis ad centrum breve cuspidatis utraque pagine hirsutis margine laciniato-fimbriatis, fimbriis filiformibus crispatis; columna staminalis inclusa cylindrica 4 mm. longa 2½ mm. lata apice truncata, antheris sigmoideis, connectivis secus antheras hirsutis. Fructus oblongus 7–8 cm. longus 6–7 cm. latus, stipite validiusculo 2 cm. longo.

HAB. Gaogan, Nantō, Taitō, Kappanzan, Wantan.

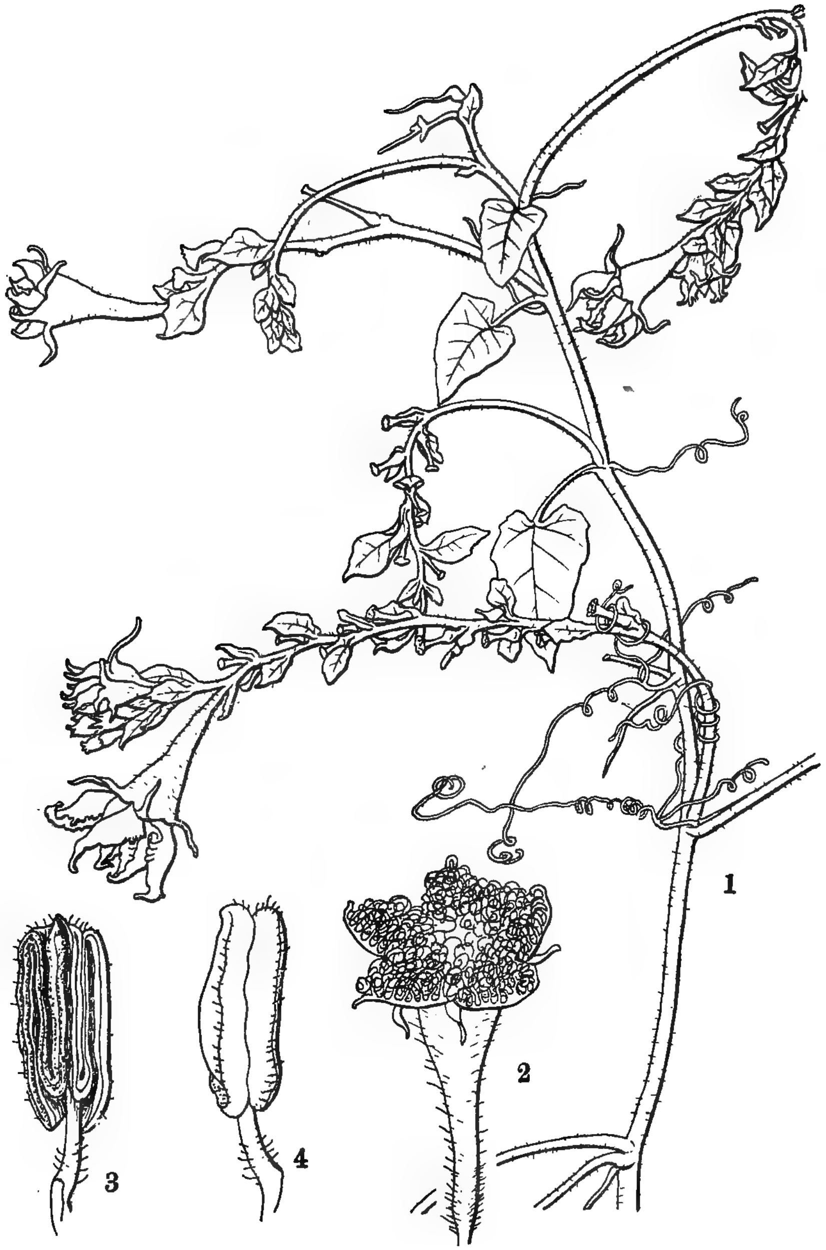

Fig. 4, *Trichosanthes homophylla* HAYATA; 1, a branch; 2, a male flower; 3, a stamen, seen from without; 4, the same, seen from within.

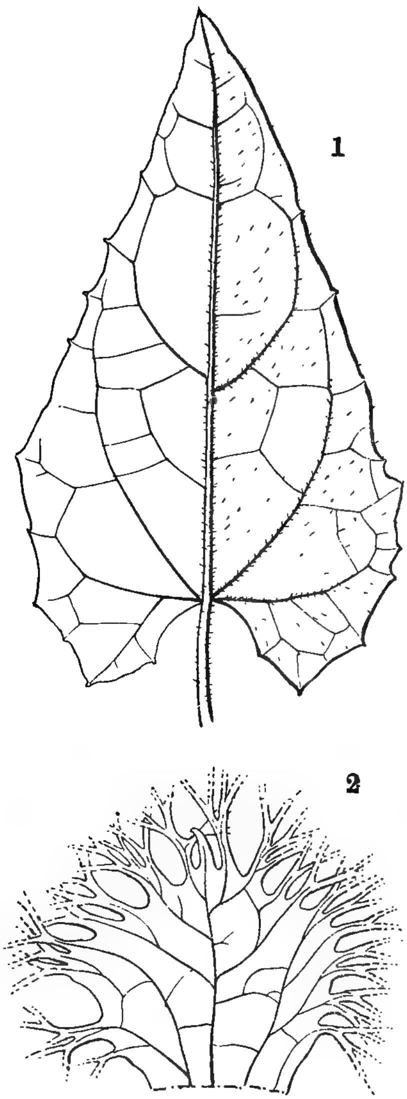

Fig. 5, *Trichosanthes homophylla* HAYATA; 1, a leaf; 2, a corolla-lobe of a male flower, marginal portions taken off.

Near *Trichosanthes integrifolia* in the leaves which are ovate, acuminate and entire, but totally different from it in the long racemes of the male flowers.

Trichosanthes koshunensis HAYATA sp. nov. Scandentissima; caulis multi-sulcatus teres glaber. Folia alterna chartacea in ambitu reniformia 9 cm. longa 12 cm. lata apice in ambitu rotundata basi reniforme cordata alte 6–7–lobata, lobis in ambitu spathulatis 6 cm. longis 3 cm. latis sursum lobulatis deorsum attenuatis partibus attenuatis 1 cm. latis, 5–nervia utraque glabra sed supra punctata margine remote mucronibus instructa, petiolis 2 cm. longis, cirrhis axillaribus trifidis. Fructus globosus 3 cm. in diametro, pedunculo 1 cm. longo solitario.

HAB. Kōshūn, Kuraru, Garanbi, leg. B. HAYATA, Jan. 1912.

Near *Trichosanthes multiloba* MIQ.

Trichosanthes Matsudai HAYATA sp. nov. Scandentissima; caulis breve dense hirsutus multi-sulcatus. Folia alterna membranacea in ambitu triangulari-cordata 7–8 cm. longa 8–9 cm. lata apice obtusissima basi alte auriculato-cordata in circumscriptione 3–lobata, lobo terminali 5 cm. longo 3½ cm. lato, margine remote mucronibus instructa supra parce subtus dense brevissime hirsuta 5–nervia, petiolis 2 cm. longis. Fructus oblongo-ellipsoideus 7–8 cm. longus 3–4 cm. latus apiculatus glaber, pedunculo crassiusculo 1 cm.

longo dense hirsuto multi-sulcato.

HAB. Banchoryō, Kōsenpo, leg. Y. MATSUDA.

Near *Trichosanthes anguina* LINN., but differs from it in the nearly glabrous leaves.

Trichosanthes Miyagii HAYATA sp. nov. Scandentissima; caulis glaber rugulosus multi-sulcatus. Folia alterna rotundato-triangularia 10 cm. longa 9 cm. lata apice triangulari-obtusa basi late cordata vel truncata margine subintegra 5-nervia utraque pagine minute elevato-punctata, petiolis 4–5 cm. longis glabris, cirrhis axillaribus 3-fidis. Racemi floris masculini 25 cm. longi axillares remote florati, bracteis rhombicis 2 cm. longis 1½ cm. latis apice triangulari-caudatis breve aristatis basi triangulari-cuneatis supra plus minus hirsutis erosis subintegris brevissime petiolatis. Flores ♂ sessiles. Calycis tubus 2½ cm. longus apice 8 mm. latus parce hirsutus infundibulari-cylindricus, lobis 5 linearibus 1 cm. longis 1–1½ mm. latis apice longe cuspidatis basi dilatatis subglabris. Petala 5 obovata 12 mm. longa 10 mm. lata apice cornuto-apiculata, apiculis 2–3 mm. longis deorsum reflexis, basi cuneata margine deorsum integra sursum fimbriata, fimbriis longissimis 2 cm. longis, extus breve hirsuta intus subglabra. Columna staminalis cylindrico-subconica 7 mm. longa 5 mm. lata apice obtusa, connectivis plus minus productis, antheris sigmoideis secus marginem hirsutis.

HAB. Okinawa, leg. T. MIYAGI Aug, 1911.

Near *T. homophylla* HAY.; but differs from it in the much broader leaves and in the venation of the latter.

Trichosanthes mushænsis HAYATA sp. nov. (Fig. 6). Scandentissima; caulis multi-sulcatus parce hirsutus. Folia alterna oblongo-ovata 7–8 cm. longa 5–7 cm. lata apice acuta acuminata ad summum aristata herbacea basi late cordata sinuata margine tenuissime dentata vel mucronibus remote instructa utraque pagine plus minus hirsuta 5-nervia, petiolis 2–3 cm. longis hirsutis, cirrhis axillaribus 3–4-fidis. Flores ♂: axillares solitarii vel gemini basi bracteatis, bracteis lineari-spathulatis 1½–2 cm. longis 4 mm. latis apice acutis utraque facie parce barbatis margine integris barbatis, pedicellis 2–3 cm. longis barbatis. Calycis tubus infundibuliformis 2 cm. longus 1½ cm. latus densissime barbatus, barbis patentissimis; lobis lineari-lanceolatis 1½ cm. longis 5 mm. latis apice caudato-linearibus barbato-hirsutis, caudis longe setæ-formibus. Petala 5 valde fimbriata in ambitu cum fimbriis 2 cm. longa 5 cm. lata, partibus non-fimbriatis late rhombicis 1½ cm. longis 2 cm. latis apice cuspidato-cornutis, cornibus reflexis 3 mm. longis ½ mm. latis, extus bartata intus parce hirsuta 3-nervia margine fimbriata, fimbriis filiformibus 1½–2 cm. longis. Columna staminalis in tubo calycis inclusa late cylindrica 4 mm. longa 3 mm. lata, filamentis validiusculis 1½ mm. longis glabris; antheris linearibus sigmoideis, connectivis apice plus minus productis secus antheras hirsutis.

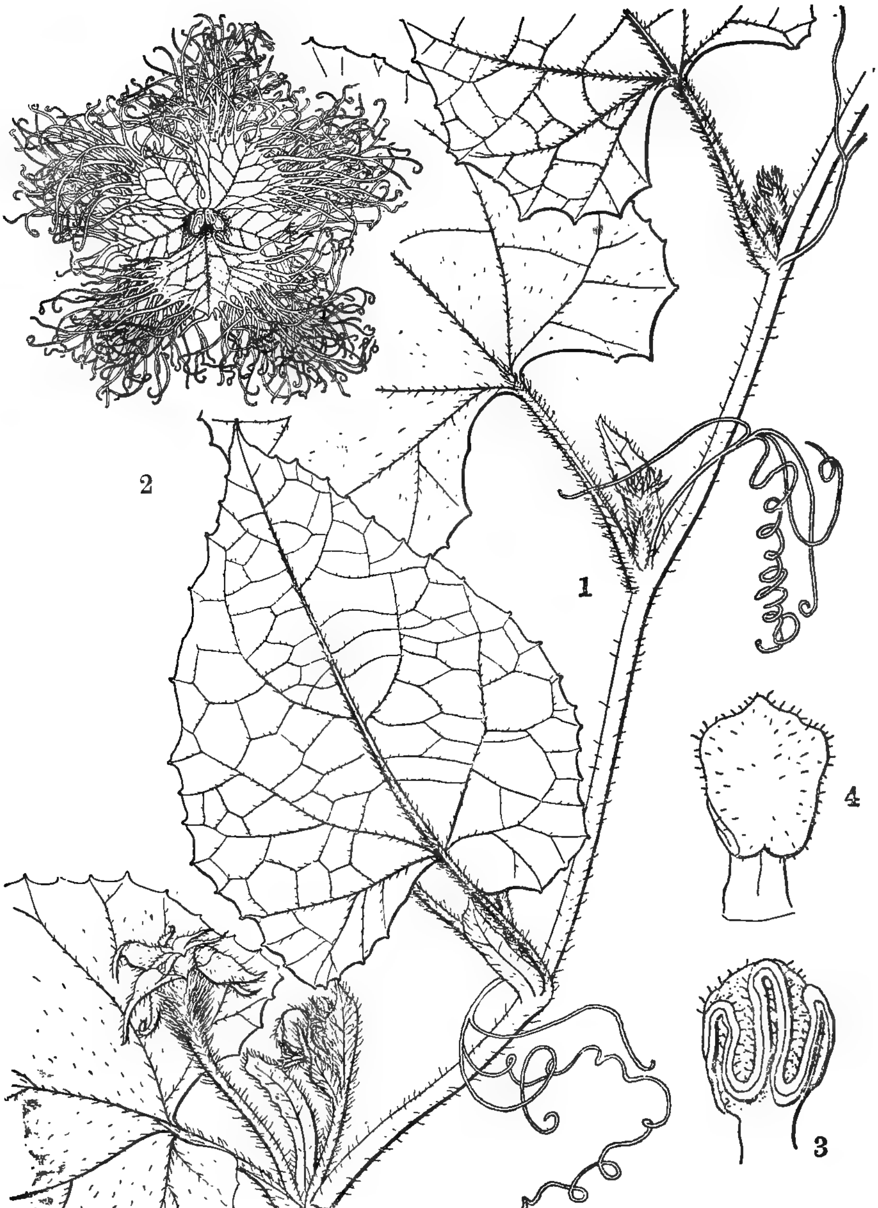

Fig. 6, *Trichosanthes mushænsis* HAYATA ; 1, a branch ; 2, a flower ; 3, a stamen; 4, the same, seen from back.

HAB. Musha, leg. B. HAYATA, Aprili. 1910. Comparable to some extent to *Trichosanthes dioica* ROXB.; but totally different from it in the thinner leaves and in the much smaller flowers.

NOTE: Flowers pale-yellow. Leaves dark-green.

Trichosanthes punctata HAYATA sp. nov. Scandentissima; caulis subglaber vel minute hirsutus multi-sulcatus. Folia alterna in ambitu cordata chartaceo-membranacea 10 cm. longa totiusque lata 5–7–lobata inter lobos sinuata, lobo terminali ovato 6 cm. longo $3\frac{1}{2}$ cm. lato apice caudato-acuminato ad centrum mucronato basi plus minus constricto margine remote mucronibus instructo, lobis basilaribus auriculiformibus, supra albo-punctata subtus glabra 5–nervia, petiolis 4 cm. longis, cirrhis axillaribus bifidis. Racemi ♂ axillares simplices 20 cm. longi 4–5–florati, bracteis late rhombicis 4 cm. longis $4\frac{1}{2}$ cm. latis margine laceratis prope basin integris glabris, laciniis cuspidiformibus longe acuminatis. Fl. ♂: ad axillas bractearum dispositi solitarii subsessiles; calycis tubis longissime infundibuliformibus basi stipitiformibus 6 cm. longis apice 12 mm. latis extus parce glanduloso-hirsutis, lobis 5 triangulari-ovatis 2 cm. longis 1 cm. latis apice acuminatis margine laciniatis utraque pagine breve hirsutis; petalis 5 margine valde fimbriatis in ambitu obovatis fimbriis exceptis $2\frac{1}{2}$ cm. longis totiusque latis extus hirsutis intus barbatis 3-5–nerviis, fimbriis longissimis; columna staminalis in tubo calycis inclusa cylindrica 12 mm. longa 6 mm. lata apice truncata, connectivis barbatis, antheris linearibus sigmoideis.

HAB. Hainan: Hoihaw, leg. Z. KATSUMADA, Juli. 1907.

Near *Trichosanthes palmata* ROXB.; but differs from it in the leaves which are minutely white-dotted above.

Trichosanthes schizostroma HAYATA sp. nov. Scandentissima; caulis subglaber multi-sulcatus. Folia alterna chartaceo-membranacea in ambitu cordata 7 cm. longa 7–8 cm. lata alte 5–7–lobata, lobo terminali longiore hastato-tricuspidato 6 cm. longo $3\frac{1}{2}$ cm. lato 3–lobato margine remote serrulato vel mucronibus remote instructo, utraque pagine plus minus scabra, petiolis 3 cm. longis subglabris, cirrhis axillaribus 3–fidis. Racemi floris masculini axillares 10 cm. longi, bracteis ovatis 5 cm. longis 3 cm. latis apice acutis basi plus minus contractis lanceolato-fimbriatis, laciniis 1–$1\frac{1}{2}$ cm. longis, glabris. Flores ignoti.

Trichosanthes multiloba HAYATA Gen. Ind. p. 31. (non MIQ.)

HAB. Kappanzan.

Near *T. multiloba* MIQ.; but differs from it in the male racemes with much larger fimbriate bracts.

Zehneria ENDL.

Zehneria kelungensis HAYATA sp. nov. (Fig. 7. et 8). Scandentissima; caulis gracilis subglaber multi-sulcatus flexuosus. Folia alterna triangulari-pentagona 4–$4\frac{1}{2}$ cm. longa 5–$5\frac{1}{2}$ cm. lata membranacea apice triangulari-acuta

Fig. 7, *Zehneria kelungensis* HAYATA; 1, a branch; 2, a fruit.

basi late sinuata vel late truncata margine late leviterque dentata ad apicem dentis mucronata 5-nervia supra scabra subtus glabra, petiolis 2 cm. longis glabris, cirrhis axillaribus simplicibus. Cymæ florum masculinorum 10-floratæ umbellatim floriferæ axillares, pedunculis 2–3 cm. longis gracillimis. Flores feminei axillares solitarii. Flores ♂: pedicellati, pedicellis 4 mm. longis glabris haud bracteatis. Calyx viridis urceolato-campanulatus 2 mm. longus 4 mm. latus glaber, lobis 4–5 minutis cuspidiformibus 1 mm. longis $\frac{1}{4}$ mm. latis glabris margine plus minus hirsutis. Petala 4–5 ovato-triangularia 2–2$\frac{1}{2}$ mm. longa 1$\frac{1}{2}$–2 mm lata apice obtusa integra utraque pagine hirsuta intus ad faucem calycis densissime albo-barbata alba demum pallido-flava. Stamina 3, filamentis 2 mm. longis glabris vel hirsutis complanatis, antheris ovatis 1 mm. longis totiusque latis extrorsis, connectivis hirsutis; rudimentum ovarii depressum pulviniforme. Fl. ♀: Ovarium inferum ampulliforme 5 mm. longum 2 mm. latum apice longe rostratum glabrum. Calyx supra ovarium expansus, partibus expansis campanulatis 2 mm. longis 3 mm. latis subglabris viridibus, lobis late cuspidiformibus 4–5 subglabris 1 mm. longis basi dilatatis $\frac{1}{2}$ mm. latis. Petala 4–5 reflexa ovato-linearia 3 mm. longa 1 mm. lata apice actuto-obtusa utraque hirsuta integra basi intus ad faucem calycis dense barbata. Staminodia 4–5 filiformia hirsuta 3 mm. longa. Stylus columniformis 4 mm. longus, stigmate dilatato 3-fido; discus annuliformis basin styli situs. Bacca ellipsoidea 1$\frac{1}{2}$ cm. longa 1 cm. lata glabra, pericarpio chartaceo. Semina valde complanata ovata 4–5 mm. longa 3 mm. lata lævia, testa crustacea, exalbuminosa. Embryo complanatus, cotyledonibus rotundatis complanatis 2 mm. in diametro angulatis, radicula minuta $\frac{1}{4}$ mm. longa conica.

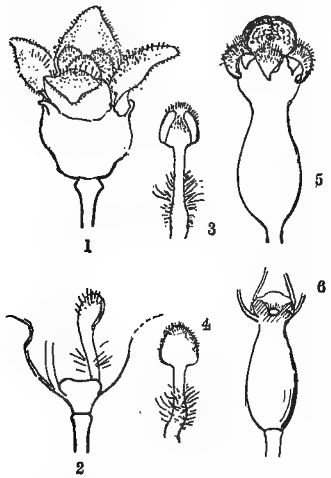

Fig. 8, *Zehneria kelungensis* HAYATA; 1, a male flower; 2, section of the same; 3, a stamen; 4, the same, seen from another side; 5, a female flower; 6, section of the same.

Melothria odorata HAYATA Gen. Ind. p. 31 (non HOOK. f. et THOMS.)

Zehneria mysorensis HAYATA Gen. Ind. p. 31 (non ARN.)

Melothria kelungensis HAYATA in Sched. Herb. Tōkyō.

HAB. Kelung, Taihoku.

Near *Z. mysorensis* ARN., but distinguishable from it in the much smaller leaves and fruits.

Umbelliferæ.

Caucalis LINN.

Caucalis scabra MAKINO in Tōkyō Bot. Mag. (1893) p. 44, (1895) p. 230; YABE Rev. Umb. Jap. p. 27.

Torilis scabra DC.; MIQ. Prol. Fl. Jap. p. 252.

HAB. Uchitaroko, Aprili. 1917, leg. B. HAYATA et S. SASAKI.

Sium LINN.

Sium formosanum HAYATA sp. nov. (Fig. 9). Herba robusta. Caulis 100 cm. longus erectus 1–1⅓ cm. in diametro sectionis. Folia alterna pinnata herbacea, pinnis oppositis 5–9 sessilibus lanceolatis 4–7 cm. longis 1–2 cm. latis apice acuminatis basi obtusis margine argute serrulatis glabris, petiolis 10 cm. longis basi dilatis caulem amplectantibus. Umbella pedunculata 6 cm. in diametro, bracteis linearibus 1 cm. longis, radiis circ. 15 rectis 2–3 cm. longis apice umbelluliferis; umbellula 5–6 mm. in diametro, radiis 10–15 rectis 3–4 mm. longis glabris, bracteolis lanceolatis 3 mm. longis ½ mm. latis acuminatis intermixtis. Flores: ovarium glabrum; calycis lobis 5 lanceolatis ½ mm. longis ¼ mm. latis acuminatis; petalis 5 oblongis concavis apice emarginatis ⅔ mm. latis cornibus interiore recurvis; staminibus 5 glabris, antheris oblongo-cordatis ⅔ mm. longis apice brevissime apiculatis; discis pulviniformibus margine undulatis; stylis 2 minutis. Fructus rotundatus latere compressus 2 mm. longus totiusque latus glaber. Carpella semi-ovoidea 2 mm. longa 1½ mm. lata, jugis 5 æqualiter prominentibus, ad commissuram plana; vittæ ad valleculam solitariæ.

HAB. Atamu, leg. G. NAKAHARA, Aug. 1905, (typus!); Taichū, Inrin.

Near *Sium nipponicum* MAXIM.; but distinguishable from it in the fruits with much more prominent ridges, and in the much more minutely serrulate leaflets.

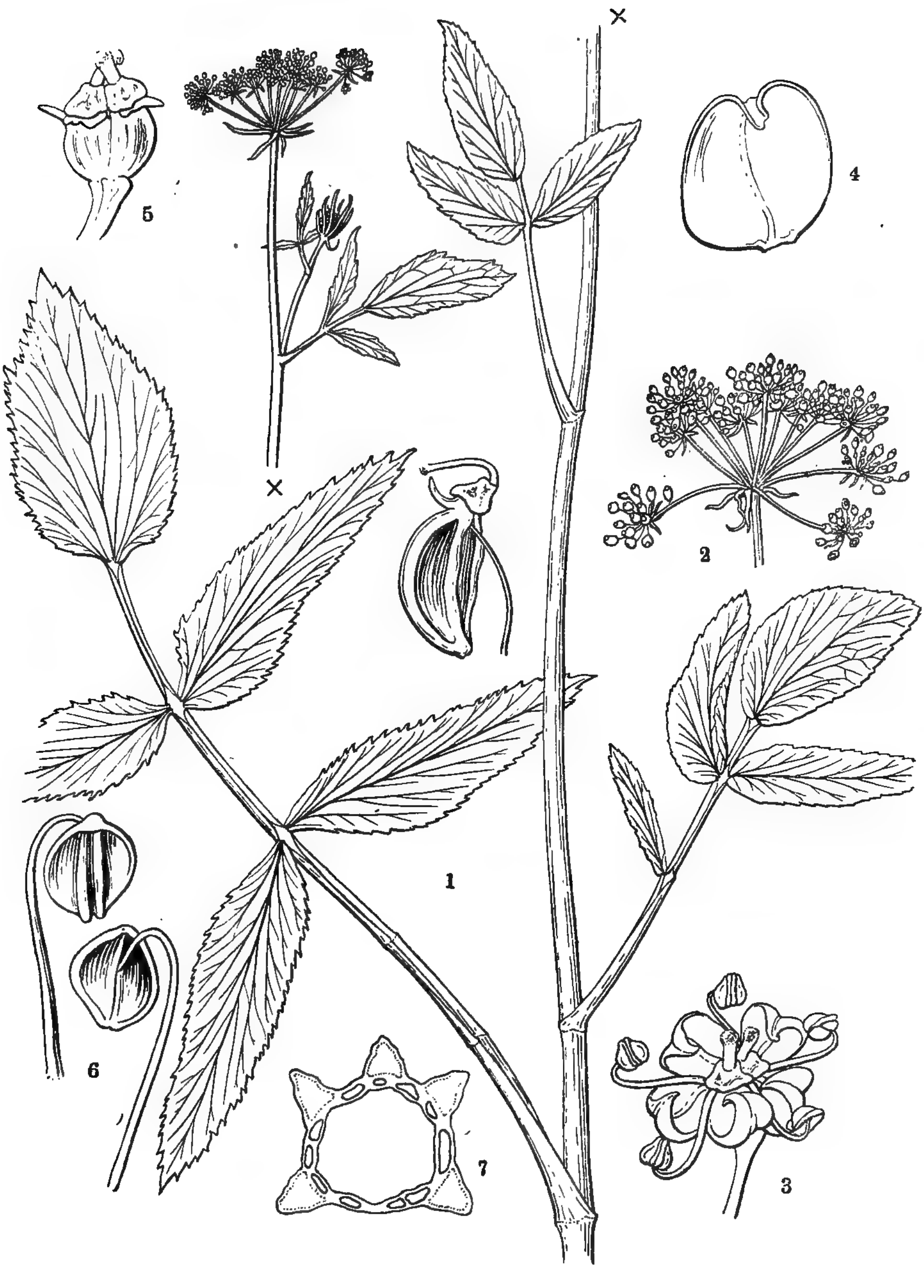

Fig. 9, *Sium formosanum* HAYATA; 1, a branch $\times\frac{6}{7}$; 2, an umbella; 3, a flower; 4, a petal; 5, a flower, petals taken off; 6, a stamen, seen from different sides; 7, section of a mature carpel.

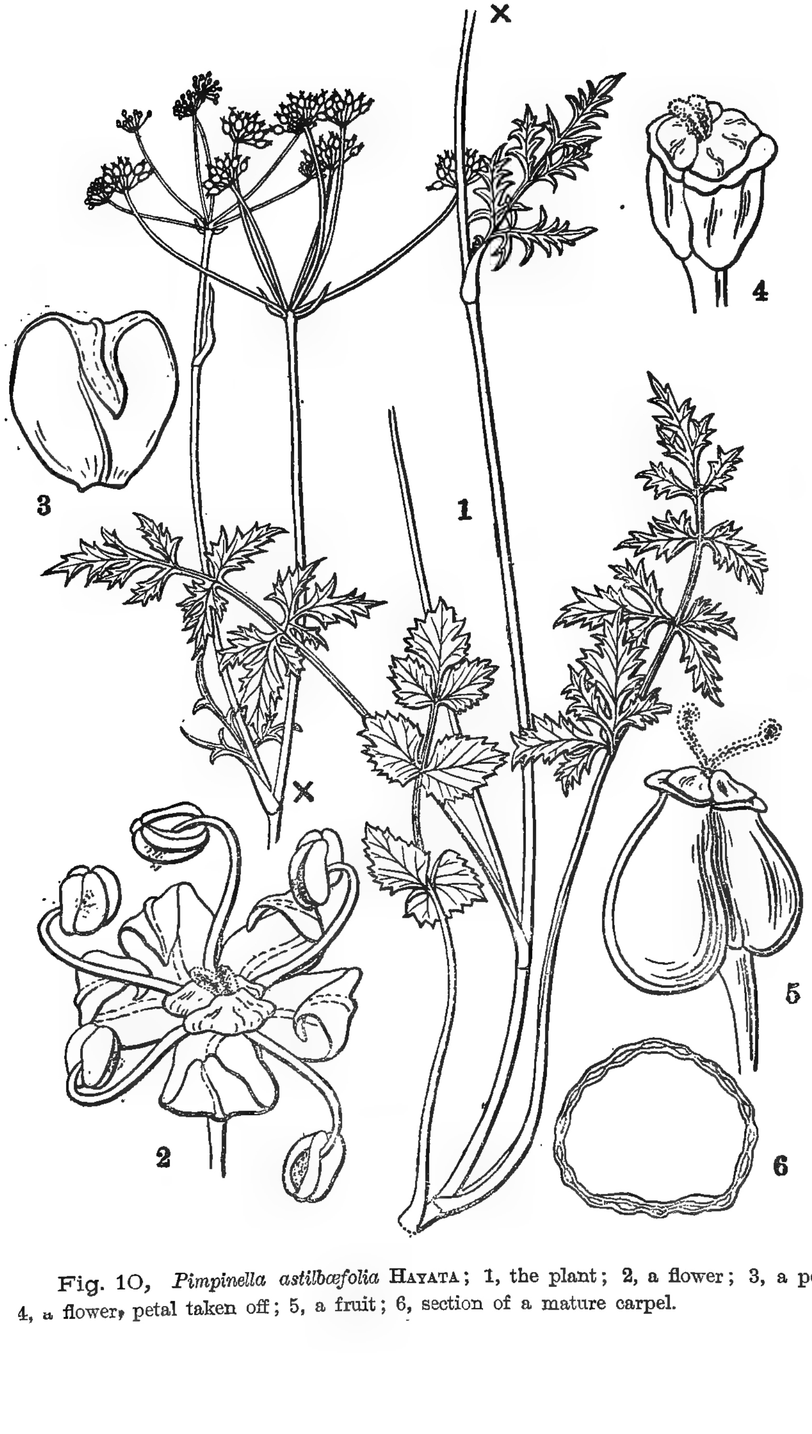

Fig. 10, *Pimpinella astilbæfolia* HAYATA; 1, the plant; 2, a flower; 3, a petal; 4, a flower, petal taken off; 5, a fruit; 6, section of a mature carpel.

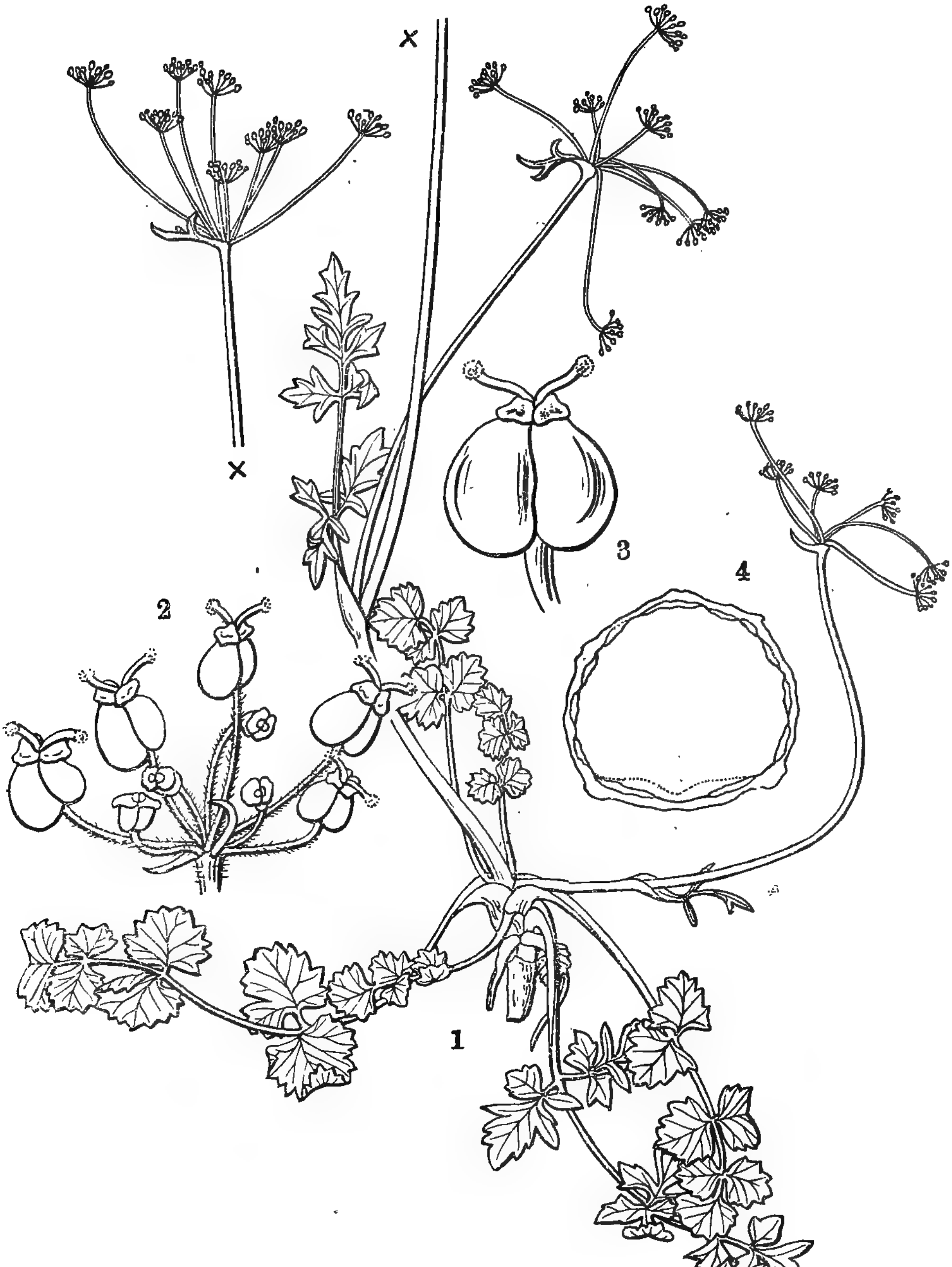

Fig. 11, *Pimpinella niitakayamensis* HAYATA; 1, the plant; 2, an umbel; 3, a fruit; 4, section of a mature carpel.

Pimpinella Linn.

Pimpinella astilbæfolia Hayata sp. nov. (Fig. 10). Herba 20–40 cm. longa. Folia dimorpha pinnata; inferiora linearia cum petiolis 8–10 cm. longa 2 cm. lata, pinnis cordatis rotundatis obliquis 1 cm. longis 1 cm. latis serrulatis, serrulis triangularibus; superiora breviora in ambitu ovata, pinnis ovatis lobulato-serratis vel trilobatis, petiolis 5 cm. longis basi dilatis caulem amplectantibus. Umbella terminalis solitaria vel ad ramos laterales disposita 5 cm. in diametro, radiis 3 cm. longis 5–7 hirsutis bracteis linearibus 5 mm. longis intermixtis; umbellula hirsuta 5–7-radiata, basi bracteolis minutis linearibus 2 mm. longis instructa, radiis 2 mm. longis. Flores: ovarium subglabrum; calycis lobis fere obsoletis; petalis 5 oblongis 1 mm. longis apice cuspidatis interiore recurvis; staminibus 5, filamentis $1\frac{1}{2}$ mm. longis glabris; discis pulviniformibus; stylis 2 minutis. Fructus cordatus latere compressus 2 mm. longus totiusque latus glaber rugulosus ad commissuram constrictus; carpella semi-cordata 2 mm. longa.

Hab. Niitakayama, Nōkōzan, Nishigundaizan. Somewhat comparable to *Pimpinella Saxifraga* Linn.

Pimpinella niitakayamensis Hayata. (Fig. 11). Gen. Ind. p. 33.

Pimpinella Saxifraga Hayata Mater. Fl. Formos. p. 128 (non Linn).

Descriptio aucta :—Fructus a latere compressus $1\frac{1}{2}$ mm. longus $1\frac{3}{4}$ mm. latus glaber. Carpella semi-rotundata $1\frac{1}{2}$ mm. longa 1 mm. lata, jugis 5 tenuissimis striiformibus.

Hab. Monte Morrison, ad 8000 ped. alt.

Differs from *P. Saxifraga* in the much smaller leaves.

Conioselinum Fisch.

Conioselinum morrisonense Hayata sp. nov. (Fig. 12). Herba 60–100 cm. longa pauce ramosa. Folia alterna bipinnata in ambitu ovata 13 cm. longa 9 cm. lata, pinnis pinnulisque linearibus pinnati-partitis, partibus oblanceolatis linearibus $1\frac{1}{2}$ cm. longis 2 mm. latis lobulatis, lobulis linearibus 2–3 mm. longis petiolulatis, petiolata, petiolis circ. 10 cm. longis basi dilatatis caulem semi-amplectantibus. Umbella ad apicem caulis vel ramorum terminaliter

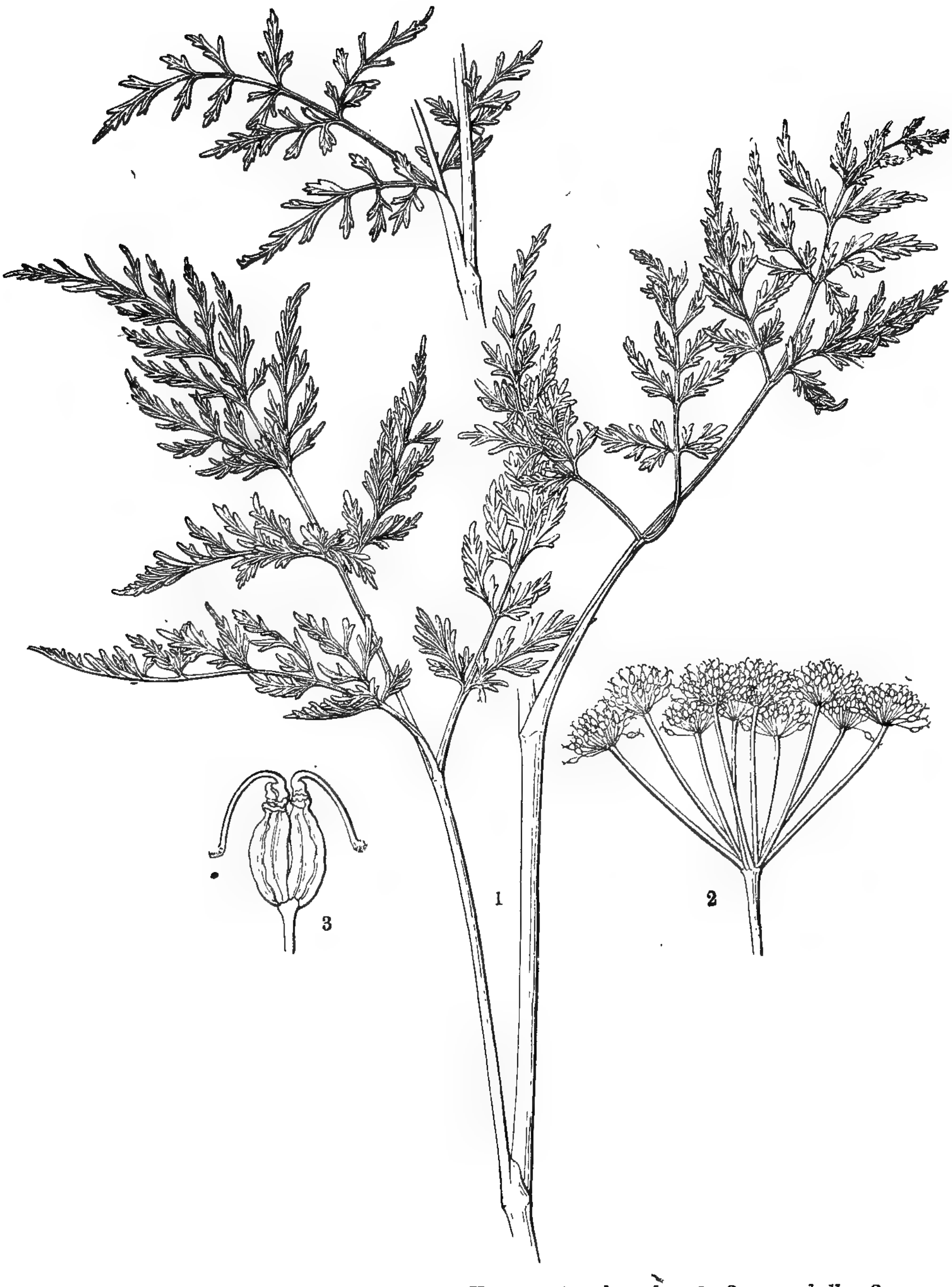

Fig. 12, *Conioselinum morrisonense* HAYATA; 1, a branch $\times \frac{3}{4}$; 2, an umbella; 3, a premature fruit.

disposita 4 cm. longa 5 cm. lata 10-radiatis, bracteis linearibus 8–9 mm. longis, radiis 3–4 cm. longis hirsutis, umbellulis 8 mm. in diametro 15-radiatis, radiis 3–4 mm. longis basi bracteolis filiformibus 1 mm. longis intermixtis. Flores: ovarium glabrum; calycis lobis fere obsoletis; petalis 5 oblongis $\frac{3}{4}$ mm. longis $\frac{1}{2}$ mm. latis apice obtusis breve apiculatis, apiculis interiore recurvis; staminibus 5, antheris cordatis minute nigro-punctatis. Fructus præmaturus oblongus $1\frac{1}{2}$ mm. longus 1 mm. latus latere compressus, stylis longiusculis secus fructus recurvatis. Carpella præmatura 5-jugata, jugis prominentibus.

HAB. Monte Morrison, ad 10000 ped. alt., leg. U. MORI.

Near *Conioselinum univittatum* TURCZ.; but differs from it in the much finer lobes and leaflets of the leaves.

Apium LINN.

Apium leptophyllum F. MUELL.; DUNN et TUTCHER Fl. Hongk. et Kwangtung. p. 116.

Helosciadium leptophyllum DC. Prodr. IV. p. 105.

HAB. Kelung, leg. S. SASAKI, Aprili. 1911.

Peucedanum LINN.

Peucedanum formosanum HAYATA sp. nov. (Fig. 13). Herba robusta 1–2 m. longa radicalia vel basilaria bi- vel tripinnata in ambitu rotundata vel triangularia 25 cm. longa totiusque lata, pinnis vel pinnulis oppositis, pinnulis ovato-triangularibus sessilibus vel petiolulatis, partibus obovato-rhombiformibus 4 cm. longis 3 cm. latis margine lobulatis, lobulis apiculatis, partibus basi cuneato-attenuatis, petiolis 15–20 cm. longis basi dilatatis caulem semi-amplectantibus. Caulis ramosus, umbellis ad apices ramorum terminalibus; umbella 2 cm. longa 4 cm. lata, radiis 10–15 rectis 2–3 cm. longis. Umbellula 1 cm. lata 20–30-radiata, radiis 2–4 mm. longis dense hirsutis basi bracteolis lanceolatis linearibus 6 mm. longis 1 mm. latis acuminatis dorso hirsutis intus glabris instructis. Flores: ovarium $\frac{1}{2}$ mm. longum 1 mm. latum hirsutum; calycis lobis minutis 5 denticuliformibus; petalis 5 oblongis $1\frac{1}{2}$ mm. longis 1 mm. latis apice cuspidatis, cuspidibus interiore recurvis; staminibus 5, antheris cordatis apice emarginatis; discis pulviniformibus margine undulatis; stylis 2 minutis.

Fig. 13, *Peusedanum formosanum* HAYATA; 1, a branch; 2, an umbella; 3, a flower; 4, a sepal; 5, a petal; 6, a flower, petals taken off; 7, a fruit; 8, a carpel, seen from within; 9, section of a mature carpel.

Fructus dorso valde compressus subrotundatus 4 mm. longus totiusque latus hirsutus; carpella 5-jugata, jugis dorsalibus 3 tenuissimis, lateralibus ad alas crassas ½ mm. latas dilatis.

Peucedanum terebinthaceum HAYATA (non FISCH.) in Gen. Ind. p. 33.

HAB. Nantō (typus!), Tōhosha, Batakan, Uchitaroko.

Near *Peucedanum terebinthaceum* FISCH.; but differs from it in the pulverulent ovary and fruits.

Angelica LINN.

Angelica formosana BOISS. (Fig. 14). in Bullet. Soc. Bot. Fr. LVI. p. 354—"Caulis ramosus, basi parce, apice densius pubescens, sulcatus, 1–2 mm. altus, purpurascens. Folia inferiora usque ad 40 cm. longa, divisione prima ternata, divisionibus secundariis pinnatisectis. Pinnulæ vel divisiones tertiariæ late ellipticæ vel sub-ovales, lateralibus sæpius inæquilatelaribus, interdum bifidis, superioribus sæpe trifidis, omnibus basi decurrentibus argute et crebre serrati-dentatis, multinerviis, glabris vel sub nervis leviter pubescentibus. Dentes pinnularum subæquales, chartacei suboblique mucronati. Folia media radicalibus subconformia sed minus divisa; superiora in vaginis oblongis saccato-ventricosis pubescentibus subsessilia, dividionibus parvis, crebre et argute dentato-serratis. Vaginæ supremæ saccatæ, oblongo-ovatæ vel ovatæ, nudæ. Involucra nulla. Umbellæ 12–30–radiatæ, radiis fere æquilongis, pubescentibus. Involucella polyphylla, phyllis linearibus, deflexis cadusis, parum albo-marginatis. Calycis dentes parvi. Petala oblongo-ovata. Stamina petalis vix longiora, antheris albis. Styli brevissimi, subparalleli. Carpella circumscriptione late elliptica vel elliptico-subovalia; mericarpia costis dorsalibus filiformibus lateralibus in alam sat latam dilatatis (ala mediam partem mericarpii subæquante). Valleculæ univittatæ; commissura bivittata.

Angelica kiusiana YABE (non MAXIM.) Revisio Umbell. Jap. in Journ. Coll. Sci. XVI. Art.–4, p. 79 (pro-parte), HAYATA Gen. Ind. p. 32.

HAB. Pachina, Sozan.

Angelica Morii HAYATA sp. nov. (Fig. 15). Folia bipinnata in ambitu triangularia 7–8 cm. longa 13 cm. lata, pinnis 3, pinnulis ovato-lanceolatis 3 cm. longis 12 mm. latis apice acuminatis basi cuneatis margine argute serrulatis, serrulis

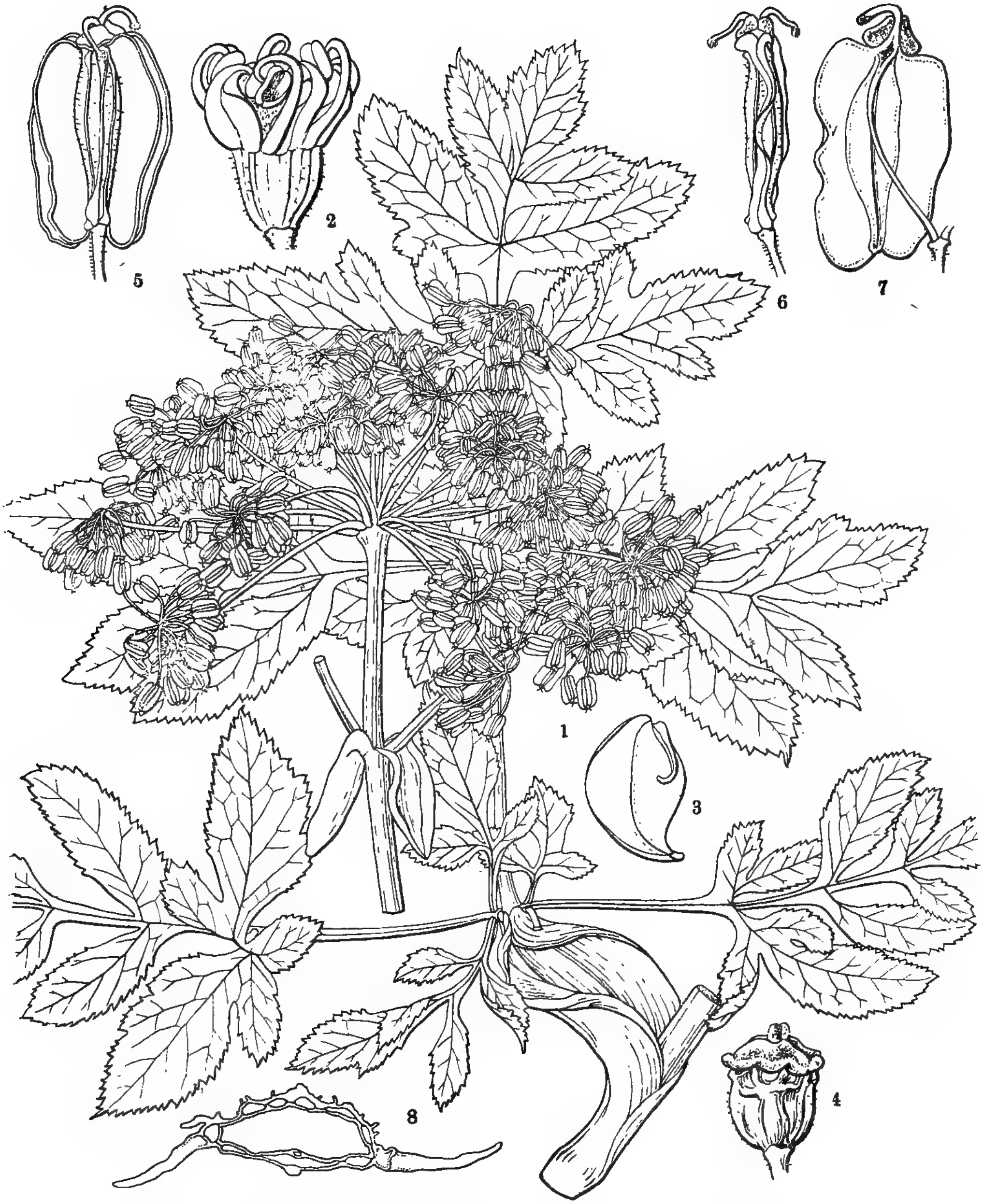

Fig. 14, *Angelica formosana* Bois.; 1, a branch $\times\frac{3}{4}$; 2, a flower; 3, a petal; 4, a flower, petals taken off; 5, a fruit: 6, the same, seen from side; 7, a carpel, seen from within; 8, section of a mature carpel.

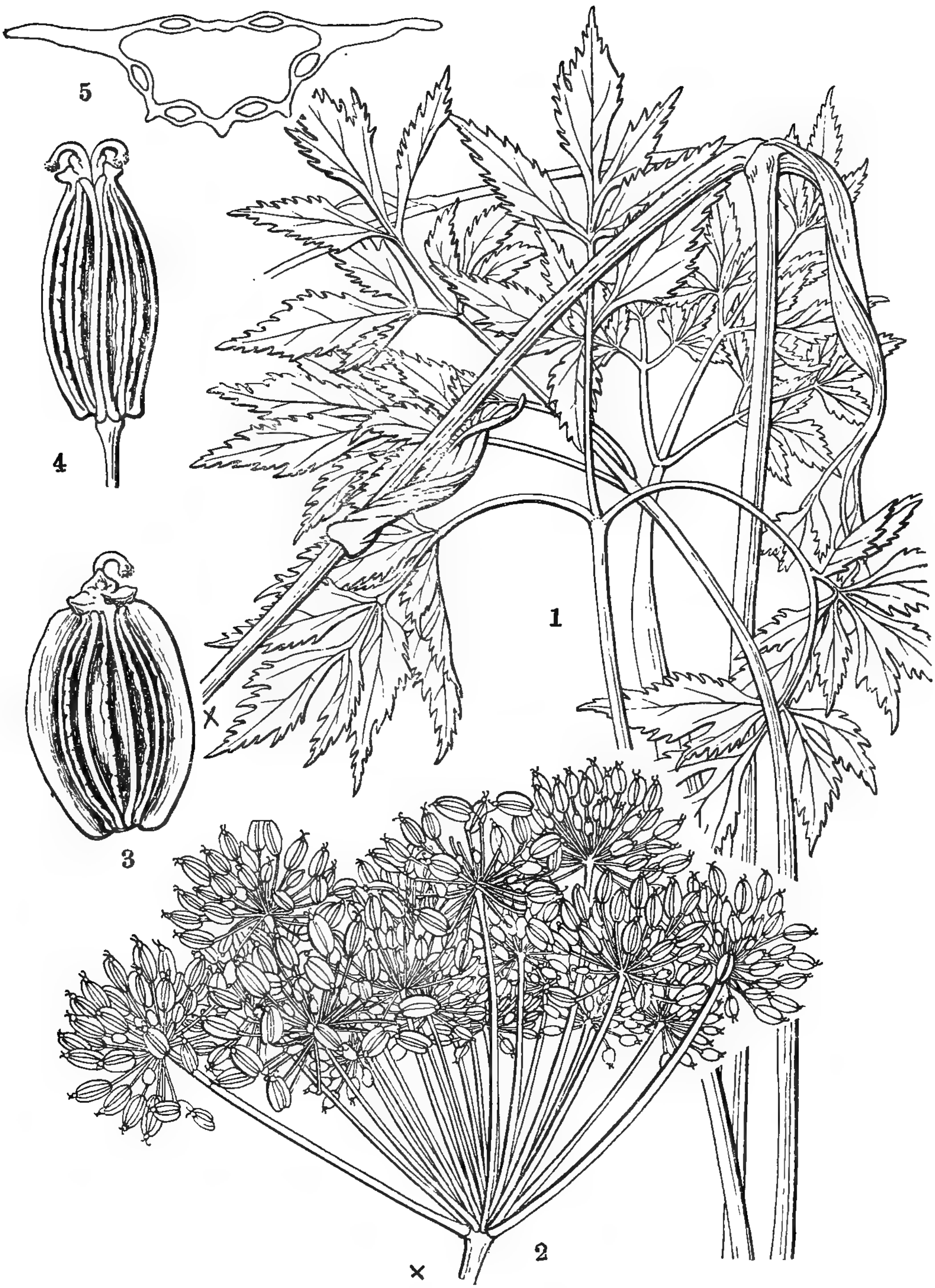

Fig. 15, *Angelica Morii* HAYATA; 1, a branch; 2, an umbella; 3, a fruit; 4, the same, seen from side; 5, section of a mature carpel.

1–2 mm. longis acuminatis; petiolis 15 cm. longis basi dilatatis stipuliformibus, caulem amplectantibus; caules fere simplices vel pauce ramosi. Umbella terminalis solitaria 6 cm. longa 10 cm. lata 20–radiata, radiis 3–6 cm. longis haud bracteatis; umbellula 15 mm. in diametro 10 mm. longa circ. 20–radiata, radiis 1 cm. longis. Fructus valde dorso compressus. Carpella oblonga 4 mm. longa 3 mm. lata basi plus minus cordata, jugis dorsalibus 3 prominentibus lateralibus late alatis.

HAB. Monte Morrison, leg. U. MORI, Oct. 1906.

Near *Angelica multisecta* MAXIM.; but differs from it in the much prominent dorsal costæ.

Angelica? tarokœnsis HAYATA sp. nov. Herba basi frutescens. Folia bipinnata ovata in ambitu 15 cm. longa totiusque lata, pinnis et pinnulis oppositis; pinnulis terminalibus et superioribus lanceolatis 5–6 cm. longis 13 mm. latis apice acuminatis basi obtusis vel attenuatis margine serrulatis sessilibus vel breve petiolulatis; inferioribus hastato-trilobatis serrulatis, petiolis 10–15 cm. longis basi dilatatis caulem amplectantibus. Umbella longe pedunculata 10–12 cm. in diametro, radiis circ. 20 haud bracteatis rectis 2–5 cm. longis glabris apice umbelluliferis; umbellula 5–7 mm. in diametro, radiis circ. 20, bracteolis linearibus 2–3 mm. longis intermixtis glabris. Flores: ovarium obconicum glabrum; calycis lobis 5 minutis oblongis $\frac{1}{8}$ mm. longis obtusis; petalis 5 oblongis $\frac{2}{3}$ mm. latis intus concavis medio intus carinatis longe apiculatis; staminibus 5, antheris ovatis apice acuto-apiculatis; discis superioribus pulviniformibus margine undulatis; stylis brevibus 2.

HAB. Inter Batakan et Naitaroko, leg. B. HAYATA et S. SASAKI, Aug. 1917.

Near *Angelica shikokiana* MAK.; but differs from it in the much smaller leaflets.

Araliaceæ.

Bœrlagiodendron HARMS.

Bœrlagiodendron pectinatum MERR. Philip. Journ. Sci. III. (c) p. 253.

Osmoxylon kotœnsis HAYATA Gen. Ind. p. 33.

Cornaceæ.

Cornus LINN.

Cornus taiwaniensis KANEHIRA Formosan Trees p. 282.

Caprifoliaceæ.

Viburnum LINN.

Viburnum cordifolium WALLICH (Fig. 16); REHDER in SARGENT Trees

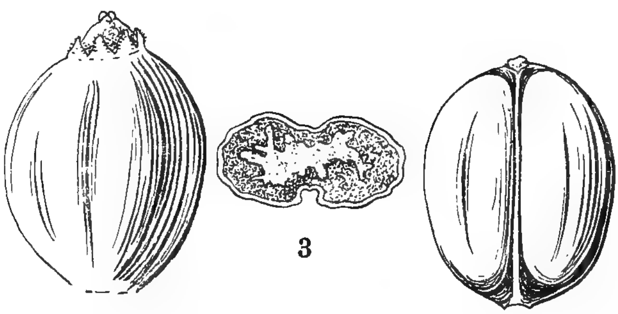

Fig. 16. *Viburnum cordifolium* WALLICH; 1, a fruit; 2, a putamen; 3, section of the same.

and Shrubs II. 81, t. 138 (1908); SARGENT, Pl. Wils. I. p. 109.

Viburnum melanophyllum HAYATA Gen. Ind. p. 34.

HAB. Rarazan, Taiheizan, Sanseizan, Gōkwanzan.

NOTE. Shrub; branches very divaricate. Flowers nearly white; fruits ellipsoid more or less complanate 7 mm. long 5 mm. broad; putamen complanate 1-sulcate on the middle on both sides

Rubiaceæ.

Mussœnda LINN.

Mussænda taiwaniana KANEHIRA Formosan Trees p. 303.

Compositæ

Anaphalis DC.

Anaphalis Nagasawai HAYATA Gen. Ind. p. 37.
Gnaphalium niitakayamense HAYATA Gen. Ind. p. 37.

Oleaceæ.

Osmanthus LOUR.

Osmanthus obovatifolius KANEHIRA Formosan Trees p. 370

Scrophularineæ.

Paulownia SIEB. et ZUCC.

Paulownia Fortunei HEMSLEY in Journ. Linn. Soc. XXVI. p. 180; SARG. Pl. Wils. I. p. 578 et III. p. 445.
Paulownia Mikado ITŌ Icon. Pl. Jap. I. tt. 9–12 (1912).
Note: Flower large, light purple.
Paulownia Kawakamii ITŌ Ic. Pl. Jap. I. tt. 15–16 (1912).
Note: Flowers smaller than the preceding species, white.

Laurineæ.

Cinnamomum BURMAN.

Cinnamomum longicarpum KANEHIRA Formosan Trees p. 425.
Cinnamomum osmophloeum KANEHIRA Formosan Trees. 428.

Machilus NEES.

Machilus nanshœnsis KANEHIRA Formosan Trees p. 449.

Elæagnaceæ.

Elœagnus LINN.

Elæagnus formosana NAKAI; KANEHIRA Formosan Trees p. 464.

Loranthaceæ.

Loranthus LINN.

Loranthus Matsudai HAYATA sp. nov. Frutex ad ramos Pini taiwanensis incolus ramosissimus, ramis fuscis lenticellis elevatis minutis notatis. Folia alterna coriacea crassa spathulata 22–25 mm. longa 6–9 mm. lata apice rotundata basi attenuata integra, petiolis 2–3 mm. longis. Cymæ ad latus ram dispositæ umbellatim 4–5–floratæ, pedunculis 3 mm. longis apice bracteis minutis cupuliforme connatis instructis; pedicellis 3 mm. longis apice bracteolis 2–3 cupuliforme connatis instructis; ovarium inferum glabrum urceolatum 1½ mm. longum 2 mm. latum; calycis limbus brevissimus ½ mm. altus margine erosus; corollæ tubus urceolato-cylindricus 1½ cm. longus 4 mm. latus glaber ruber, limbus 4–partitus, partibus secus tubum corollæ reflexis linearibus 5 mm. longis 1 mm latis apice acutis valvatis; staminibus 4 ad faucem tubi corollæ affixis erectis exsertis, filamentis 2 mm. longis ⅓ mm. latis glabris complanatis, antheris linearibus 3 mm. longis 1 mm. latis apice obtusis adnatis introrsis; stylus exsertus filiformis 22 mm. longus glaber tetragonus apice clavatim incrassatus.

Loranthus Kœmpferi HAYATA Gen. Ind. p. 64 (non MIXIM.).

HAB. Nantō: Saramao, leg. Y. MATSUDA, Aug. 1919.

Very near *L. Kœmpferi* MAXIM.; but differs from it in the much more exserted stamens and ciliate calyx (involucre).

Euphorbiaceæ.

Antidesma LINN.

Antidesma kotœnsis KANEHIRA Formosan Trees p. 472.

Cupuliferæ.

Lithocarpus BLUME.

Lithocarpus shinsuiensis HAYATA et KANEHIRA (Fig. 17). Arbor; truncus altus 120 cm. in diametro sectionis, cortice squamose soluto. Folia altera coriacea

Fig. 17, *Lithocarpus shinsuiensis* HAY. et KAN.

lanceolata 14–19 cm. longa 3½ cm.—4½ cm. lata apice acuminata basi acuta utraque glabra integra supra nitida subtus pallidissima opaca, costa utraque pagine elevata, venis lateralibus tenuissimis a costa angulo 45° egressis, petiolis 1 cm. longis. Fructus spicatus; spica validiuscula; cupula alte cupuliformis 1½ cm. alta 2 cm. lata basi ad stipitem ½ cm. longum 7 mm. latum abeuns extus squamata, squamis minutis cuspidiformibus depresse adnato-depressis 1 mm. longis multi-seriatim dispositis; glans conico-globosa 18 mm. longa totiusque lata apice acuta ad summum apiculata basi truncata, cicatrice impresso 11 mm. in diametro.

HAB. Kōshūn: Shinsuiye, ad 4000–5000 ped alt.; Marippa ad 2000 ped. alt., leg. R. KANEHIRA, Dec. 1918.

Near *L. amygdalifolia* in the leaves, but quite different from it in having cups covering glands nearly half-way up of their length.

Orchideæ.

Platanthera RICH.

Platanthera stenosepala SCHLTR. Orch. Sino.-Jap. Prodr. p. 45.
HAB. In arigillosis Taitum, 600 mm. rara, U. FAURIE.

Dendrobium SW.

Dendrobium Miyakei SCHLTR. Orch. Sino.-Jap. Prodr. p. 64.
HAB. Kotosho, leg. K. MIYAKE, Nov. 1899.

Amitostigma SCHLTR.

Amitostigma Tominagai (HAYATA) SCHLTR. l.c. p. 95.
Gymnadenia Tominagai HAYATA Ic. Pl. Formos. VI. p. 93.

Phyllomphax SCHLTR.

Phyllomphax truncatolabellata SCHLTR. l. c. p. 119.
Platanthera truncatolabellata HAYATA Ic. Pl. Formos. IV. p. 124.
Platanthera obcordata HAYATA Mater. Fl. Formos. p. 356.

Habenaria WILLD.

Habenaria formosana SCHLTR. l.c. p. 127.

Habenaria tentaculata RCHB. f. var. *acutifolia* HAYATA Mater. Fl. Formos. p. 354.

Habenaria Hayatæana SCHLTR. l.c. p. 129.

Habenaria goodyeroides D. DON var. *formosana* HAYATA Ic. Pl. Formos. IV. p. 126.

Epipogum G. S. GMEL.

Epipogum kusukusense (HAYATA) SCHLTR. l.c. p. 153.

Galera kusukusensis HAYATA Ic. Pl. Formos. IV. p. 121, t. 20.

Epipogum Rolfei (HAYATA) SCHLTR. l.c. p. 153.

Galera Rolfei HAYATA Mater. Fl. Formos. p. 348.

Spiranthes L. C. RICH.

Spiranthes suishænsis SCHLTR. Orchid. Sino-jap. Prodr. p. 161.

Spiranthes australis LINDL. var. *suishœnsis* HAYATA Ic. Pl. Formos. VI. p. 86.

Erythrodes BL.

Erythrodes formosana SCHLTR. l. c. p. 169.

Physurus chinensis ROLFE; HAYATA Ic. Pl. Formos. IV. p. 99, et VI. p. 87.

Cheirostylis BL.

Cheirostylis Takeoi (HAYATA) SCHLTR. l. c. p. 171.

Arisanorchis Takeoi HAYATA Ic. Pl. Formos. IV. p. 110.

Oreorchis LDL.

Oreorchis gracillima SCHLTR. l. c. p. 223.

Oreorchis gracilis FR. et SAV. var. *gracillima* HAYATA Ic. Pl. Formos. II. p. 141.

Oreorchis subcapitata SCHLTR. l. c. p. 225.

Oreorchis Fargesii FINET var. *subcapitata* HAYATA Ic. Pl. Formos. II. p. 142.

Pachystoma BLUME.

Pachystoma formosanum SCHLTR. l.c. p. 245.

Pachystoma chinensis HAYATA Mat. Fl. Formos. p. 321.

Thrixspermum LOUR.

Thrixspermum formosanum (HAYATA) SCHLTR. l. c. p. 273.

Sarcochilus formosanus HAYATA Mater. Fl. Formos. p. 336.

Thrixspermum kusukusense (HAYATA) SCHLTR. l. c. p. 274.

Sarcochilus kusukusensis HAYATA Ic. Pl. Formos. VI. p. 84.

Thrixspermum pendulicaule (HAYATA) SCHLTR. l. c. p. 274.

Dendrobium pendulicaule HAYATA Ic. Pl. Formos. IV. p. 44, fig. 16.

Aporum pendulicaule HAYATA Ic. Pl. Formos. IV. p. 44.

Thrixspermum Pricei (ROLFE) SCHLTR. l. c. p. 274.

Dendrocolla Pricei ROLFE in Kew Bull. (1914) p. 144.

Thrixspermum Saruwatarii (HAYATA) SCHLTR. Orchid. Sino-Jap. Prodr p. 275.

Sarcochilus Saruwatarii HAYATA Ic. Pl. Formos. VI. p. 84, fig. 18.

Ascocentrum SCHLTR.

Ascocentrum ? pumilum (HAYATA) SCHLTR. l. c. p. 285.

Saccolabium pumilum HAYATA in Tōkyō Bot. Mag. XX. p. 76.

Holcoglossum SCHLTR.

Holcoglossum quasipinifolium (HAYATA) SCHLTR. l. c. p. 285.

Saccolabium quasipinifolium HAYATA Ic. Pl. Formos. II. p. 144.

Trichoglottis BLUME.

Trichoglottis breviracema (HAYATA) SCHLTR. l.c. p. 286.

Cleisostoma breviracema HAYATA Mater. Fl. Formos. p. 338.

Trichoglottis oblongisepala (HAYATA) SCHLTR. l. c. p. 286.
Cleisostoma oblongisepala HAYATA Ic. Pl. Formos. II. p. 134.

Gastrochilus D. DON.

Gastrochilus formosanus HAYATA Gen. Ind. p. 78.
Gastrochilus formosanus SCHLTR. l. c. p. 288.
Saccolabium formosanum HAYATA Mater. Fl. Formos. p. 336.
Gastrochilus fuscopunctatus HAYATA Gen. Ind. p. 78.
Gastrochilus fuscopunctatus SCHLTR. l. c. p. 288.
Saccolabium fuscopunctatum HAYATA Ic. Pl. Formos. II. p. 143.
Gastrochilus retrocallosus HAYATA Gen. Ind. p. 79.
Gastrochilus retrocallosus SCHLTR. l. c. p. 289.
Saccolabium retrocallosum HAYATA Ic. Pl. Formos. IV. p. 92, fig. 47.
Gastrochilus Somai HAYATA Gen. Ind. p. 79.
Gastrochilus Somai SCHLTR. l. c. p. 289.
Saccolabium Somai HAYATA Ic. Pl. Formos. IV. p. 93.

Pomatocalpa BREDA.

Pomatocarpa brachybotryum HAYATA Gen. Ind. p. 81.
Pomatocarpa brachybotryum SCHLTR. l. c. p. 291.
Cleisostoma brachybotryum HAYATA Ic. Pl. Formos. IV. p. 95, fig. 49.

Scitamineæ.

Zingiber ADANS.

Zingiber Kawagoii HAYATA sp. nov. Rhizoma incrassatum breve subrepens subteres 1 cm. in diametro sectionis radices fibrosas emittens. Caulis sterilis foliifer 30–60 cm. longus simplex erectus a $\frac{1}{3}$ altitudine sursum foliatus subcomplanatus tenuiter hirsutus vaginis foliorum perfecte amplexus. Folia disticha elongato-oblonga vel oblongo-lanceolata 20 cm. longa 6 cm. lata apice acuminata basi obtusa margine integra utraque pagine tenuissime pubescentia, costa supra impressa subtus elevata, petiolis brevissimis, vaginis 4–5 cm. longis latere uno fissis caulem amplectantibus, ligulis auriculiformibus 2-lobatis.

Caulis florifer vel racemus ex apice vel latere rhizomatis oriundus 4–5 cm. longus multi-floratus. Tubi perianthii 2–3 cm. longi graciles erecti glabri basi bracteati, bracteis exterioribus squamatis lanceolatis basi vaginiformibus 2 cm. longis, intimis cylindricis 1 cm. longis apice uno latere fissis truncatis basi hirsutis ecoloratis. Sepala (lobi exteriores perianthii) 3 purpurascentia 2 cm. longa; posticum latius 9 mm. latum convavum apice obtusum; lateralia angustiora 5 mm. lata apice obtusa. Petala 0. Labellum in ambitu obovatum 22 mm. longum 20 mm. latum 3-lobatum, lobo centrali obovato-oblongo 1½ cm. longo 12 mm. lato apice emarginato margine integro atro-violaceo glabro, lobis lateralibus minoribus oblongis obliquis apice truncatis apice margineque violaceis basi medio flavescentibus. Stamen 1 subsessile, anthera lineari subtereti 1 cm. longa 2-loculari, connectivo lineari apice longe producto, partibus productis linearibus 1 cm. longis atro-violascentibus apice obtusis recurvis. Stylus filiformis albus per antheram sub parte producta connectivi dispositus glaber apice dilatatus 1 mm. latus infundibuliformis margine ciliolatus. Ovarium....

HAB. Funkiko, leg. S. KAWAGOI.

Dioscoreaceæ.

Dioscorea LINN.

Dioscorea Benthamii PRAIN et BURKILL.; DUNN et TUTCHER Fl. Kwangt. Hongk. p. 276.

HAB. Shūshū, Rinkiho, Holisha.

Dioscorea doryophora HANCE (Fig. 18); HAYATA Gen. Ind. p. 84.

HAB. Nantō, Takaw, Suubonsha.

Dioscorea kelungensis HAYATA sp. nov. (Fig. 19). Volubilis; caulis gracilis teres glaber. Folia alterna triangulari-oblonga vel lanceolata 5–10 cm. longa 4–5 cm. lata apice caudato-acuminata vel acuminata basi late auriculata margine undulata vel integra utraque glabra 7-nervia, petiolis 4–5 cm. longis glabris. Fl. ♂: spicata, spicis axillaribus solitariis gracillimis glabris 15 cm. longis triquetris remote floriferis, floribus ad nodos geminatis sessilibus basi 1-bracteatis, bracteis late ovatis membranaceis 1½ mm. longis latisque apice cuspidatis basi dilatis; perianthium late obconicum 1½ mm. longum 3 mm.

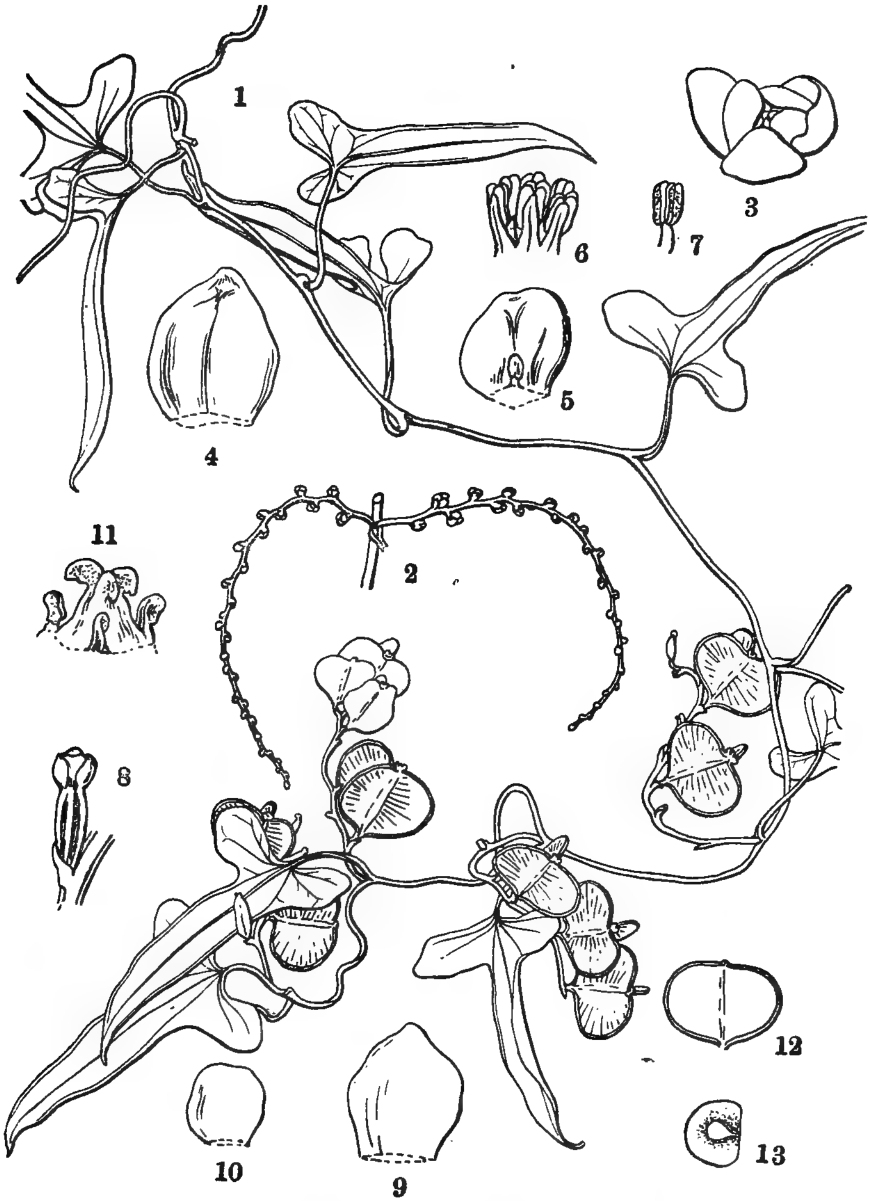

Fig. 18, *Dioscorea doryophora* HANCE; 1, a branch; 2, male spikes; 3, a male flower; 4, an outer segment of the same; 5, an inner segment of the same; 6, a cluster of stamens; 7, a stamen; 8, a female flower; 9, an outer segment of the same; 10, an inner segment of the same; 11, stigmatic column with rudimentary stamens; 12, a capsule; 13, a seed.

Fig. 19. *Dioscorea kelungensis* HAYATA; 1, the plant; 2, a male flower; 3, 4, a stamen, seen from different sides; 5, a female flower; 6, apical portion of a female flower, partly taken off.

latum medio sursum 6-lobatum, lobis late triangularibus apice acutis patentibus glabris; staminibus 3, filamentis $\frac{1}{4}$ mm. longis glabris, connectivis dilatatis, loculis antherarum remotis; staminodiis 3 minutis; rudimentum ovarii minutum conicum apice 3-fidum. Fl. ♀: spicati, spicis solitariis 5 cm. longis glabris gracillimis triquetris; floribus sessilibus ad nodos solitariis basi bracteatis, bracteis late ovatis $1\frac{1}{3}$ mm. longis 1 mm. latis apice cuspidatis; ovarium inferum 5 mm. longum 1 mm. latum glabrum triquetrum; perianthii lobis rotundatis $\frac{2}{3}$ mm. longis et latis glabris; staminodiis 6 minutis; stylo columniformi $\frac{1}{2}$ mm. longo apice 3-fido, segmentis recurvis. Capsulæ cum alis obcordatæ 2 cm. longæ totiusque latæ apice leviter cordatæ basi obtuso-rotundatæ. Semina valde complanata rotundata circumcirca ala membranacea cincta.

Dioscorea Tokoro HAYATA Gen. Ind. p. 84 (non MAKINO).

HAB. Kelung, leg. B. HAYATA (typus!); Busegan, Seisui, Keitao, Taroko, Shinjiō, Batakan, Gaogan.

Near *Dioscorea Tokoro*, but differs from it in the much broader capsules.

Dioscorea Matsudai HAYATA sp. nov. (Fig. 20). Volubilis; caulis complanato-teres glaber gracilis. Folia opposita vel alterna lanceolata vel oblongo-lanceolata chartacea 6–9 cm. longa $2\frac{1}{2}$–3 cm. lata apice acuta vel acuminata basi rotundata vel obtusa utraque glabra 5-nervia, petiolis 2 cm. longis glabris gracilibus. Flores ♂ paniculati, paniculis axillaribus solitariis 5–6 cm. longis ramosissimis, floribus ad nodos solitariis basi bracteatis, bracteis ovato-triangularibus $\frac{2}{3}$ mm. longis cuspidatis; perianthii segmentis 6, exterioribus 3 majoribus rotundatis $1\frac{2}{3}$ mm. in diametro glabris valde concavis, interioribus minoribus; staminibus 6, filamentis complanatis glabris $\frac{1}{2}$ mm. longis, antheris oblongis $\frac{1}{3}$ mm. longis. Capsulæ cum alis $3\frac{1}{2}$–4 cm. latæ $2\frac{1}{2}$ cm. longæ breve stipitatæ.

HAB. Monte Buisan, leg. Y. MATSUDA, Juli. 1918, (typus!); inter Karapin et Suisharyō, Kelung, Ōchōbi, leg. B. HAYATA.

Near *D. rhipogonoides*, but differs from it in having much thinner leaves; also allied to *D. oppositifolia*, but distinguishable from it in the much longer male spikes.

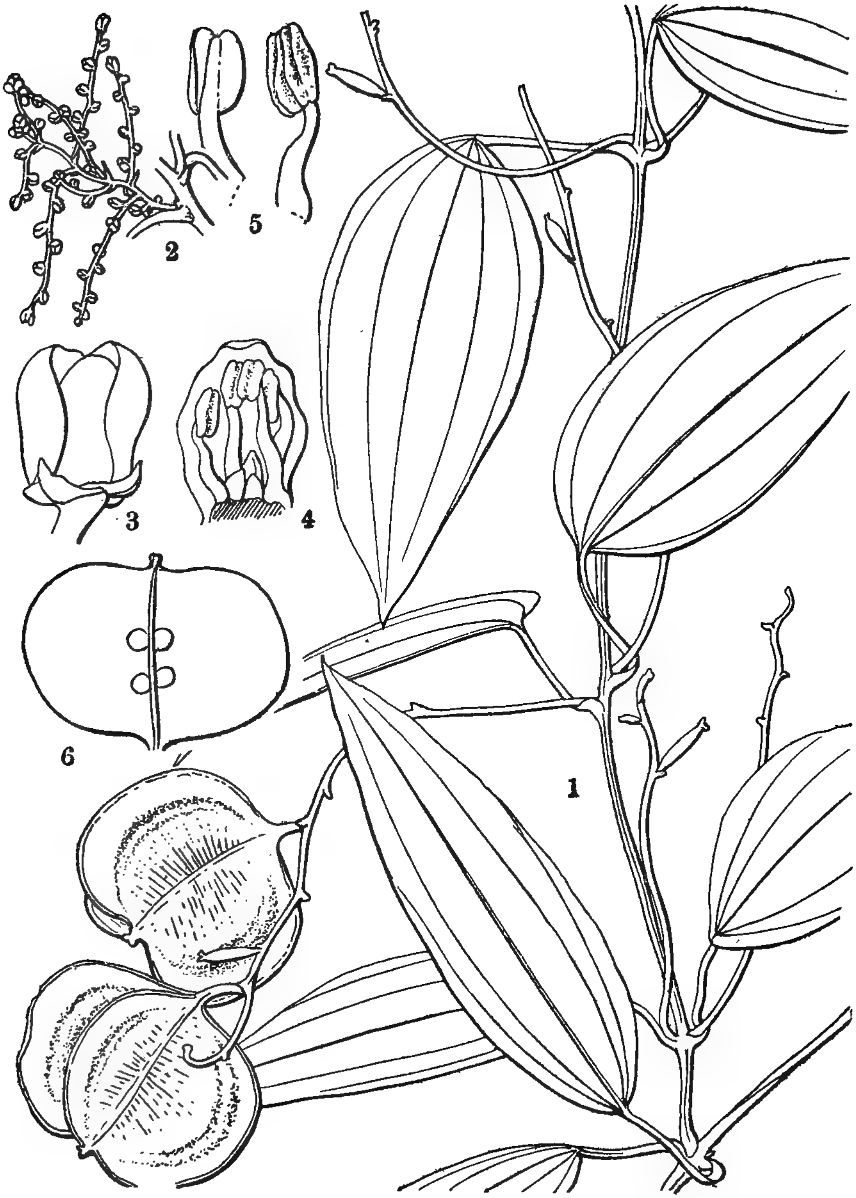

Fig. 20, *Dioscorea Matsudai* HAYATA; 1, a branch; 2, a male inflorescence; 3, a male flower; 4, the same, some segments taken off, to show stamens; 5, a stamen seen from different sides; 6, a capsule, showing young seeds.

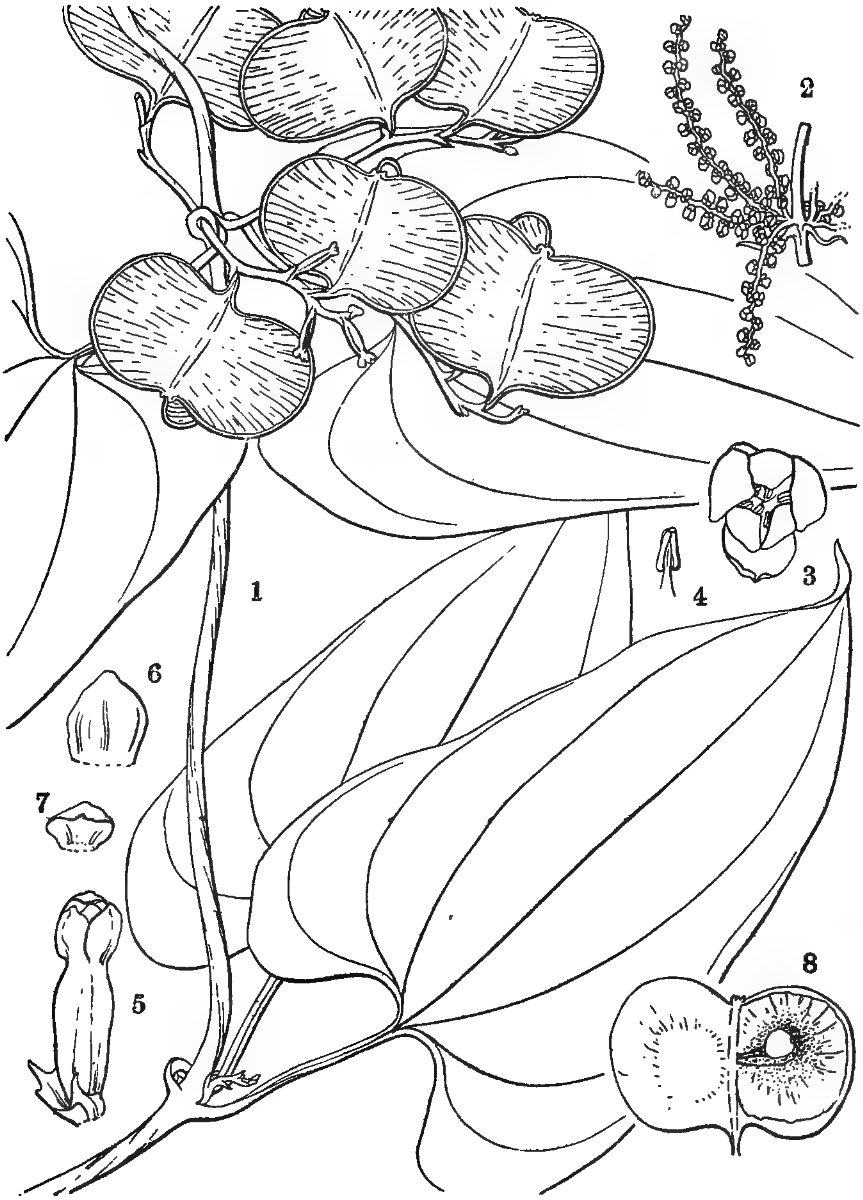

Fig. 21, *Dioscorea pseudojaponica* HAYATA; 1, a branch; 2, male inflorescence; 3, a male flower; 4, a stamen; 5, a female flower; 6, an outer segment of the same; 7, an inner segment of the same; 8, a capsule, one valve taken off, to show a seed.

Dioscorea pseudojaponica HAYATA sp. nov. (Fig. 21). Volubilis; caulis complanato-teres glaber. Folia opposita triangulari-ovata vel -oblonga chartaceo-membranacea 6–10 cm. longa 5½–6 cm. lata apice caudato-acuta basi lata auriculata margine subintegra 7-nervia utraque glabra, petiolis 3–4 cm. longis glabris gracilibus. Fl. ♂: spicati, spicis ad axillas foliorum verticillatim sitis simplicibus 3 cm. longis glabris gracilibus triquetris subalatis, floribus sessilibus semi-clausis, bracteis triangularibus cuspidatis 1 mm. longis; perianthium globosum 2 mm. in diametro, segmentis 6 rubro-punctatis valde imbricatis, 3-exterioribus majoribus rotundato-oblongis 1½ mm. longis valde concavis glabris apice obtusis, interioribus minoribus; staminibus 6 subsessilibus, antheris oblongis ⅔ mm. longis apice emarginatis; rudimentum ovarii 0. Flores ♀: ignoti. Capsulæ cum alis late reniformes 3 cm. latæ 18 mm. longæ basi apiceque cordatæ. Semina valde complanata circumcirca ala membranacea cincta cum alis 18 mm. in diametro.

Dioscorea japonica et *rhipogonoides* HAYATA Gen. Ind. p. 84.

HAB. Shichiseitonzan, Rarazan, Gukutsu, Ritōzan, Masō, Kelung, Tamsui, Gaogan, Taikokan, Byōritsu-Taiko.

Very near *Dioscorea japonica* THUNB.; but differs from it in the much larger capsules and in the quite obtuse anthers which are not appendiculate at the apex.

Dioscorea alata LINN. (Fig. 22). Volubilis; caulis teres glaber lævis 4-alatus, alis undulatis 1–2 mm. latis. Folia opposita oblongo-cordata vel oblongo-criangularia 10–12 cm. longa 5–6 cm. lata apice acuminata basi cordata vel tordato-auriculata ad centrum acuta margine integra chartacea utraque pagine glabra 7-nervia, nervis supra haud subtus prominente elevatis, venulis tenuissimis, petiolis 5–6 cm. longis gracilibus glabris tenuiter 4-alatis, alis basi decurrentibus ad auriculas dilatis. Racemi axillares fructiferi 15 cm.–20 cm. longi glabri 4-alati. Capsulæ prematuræ cum alis in ambitu obovoideæ, alis 3 latis 5 mm. latis basi attenuatis, stipitibus 2 mm. longis glabris.

HAB. Banchoryō: Rōnō, leg. U. MORI, No. 5523, Nov. 1907.

Nearly identical with the figure given in WIGHT Ic. t. 810; but somewhat differs from it in having ovately cordate leaves.

Fig. 22, *Dioscorea alata* LINN.

Dioscorea raishæensis HAYATA sp. nov. (Fig. 23). Volubilis; caulis complanato-teres glaber. Folia opposita chartacea oblongo-ovata 9–12 cm. longa $5\frac{1}{2}$–8 cm. lata apice cuspidato-acuminata basi cordato-auriculata integra 7-nervia utraque glabra, petiolis 6–7 cm. longis gracilibus glabris. Paniculæ axillares 15–20 cm. longæ 3–4 cm. latæ, ramis paniculæ ad nodos verticillatis 2–3 cm. longis simplicibus valde flexuosis glabris flores spicatim gerentibus. Fl. ♂: sessiles basi 1-bracteati, bracteis singularibus triangularibus 1 mm. longis $1\frac{1}{2}$ mm. latis apice cuspidatis latere bracteolis singulis minutis instructis. Segmenta perianthii 6; exteriora 3 majora oblonga concava $1\frac{1}{2}$ mm. longa $1\frac{1}{4}$ mm. lata apice obtusa glabra, interiora crassiuscula obovato-rhomboidea $1\frac{1}{5}$ mm. longa totiusque lata apice triangulari-obtusa basi cuneata. Stamina 6 ad centrum floris congesta subsessilia, antheris rotundatis utrinque emarginatis. Rudimentum ovarii minutum. Fl. ♀ ignoti.

HAB. Akō: Raisha, leg. Y. MATSUDA, Nov. 1917.

Near *Dioscorea japonica* THUNB.; but differs from it in the paniculate male spikes.

Dioscorea sativa LINN. (Fig. 24); HAYATA Gen. Ind. p. 84.

HAB. Takaw, Nantō: Batsu-sha-ho; Urai, Kusshaku.

Dioscorea tarokœnsis HAYATA sp. nov. (Fig. 25). Volubilis; caulis complanato-teres glaber. Folia opposita oblonga chartacea 6–7 cm. longa $2\frac{1}{2}$–3 cm. lata apice cuspidato-acuminata basi rotundata 5-nervia margine integra, petiols. $1\frac{1}{2}$–2 cm. longis glabris. Flores ignoti. Spicæ fructiferæ circ. 10 cm. longæi Capsulæ cum alis ob-reniformes 3 cm. latæ 2 cm. longæ apice obcordatæ basi truncatæ ad centrum subito acutæ, stipitibus 1 mm. longis. Semina valde complanata.

Dioscorea glabra HAYATA Gen. Ind. p. 84 (non ROXB.).

Dioscorea oppositifolia HAYATA Gen. Ind. p. 84 (non LINN.).

HAB. Taroko, leg. G. NAKAHARA, Jan. 1906.

Near *Dioscorea rhipogonoides* OLIV.; but differs from it in having much thinner leaves; also allied to *D. Matsudai* HAY., but distinguishable from it in the leaves with finer veinlets which are not visible on the upper side.

Dioscorea Tashiroi HAYATA sp. nov. (Fig. 26). Volubilis; caulis teres glaber exalatus. Folia alterna membranacea cordato-ovata 8–15 cm. longa

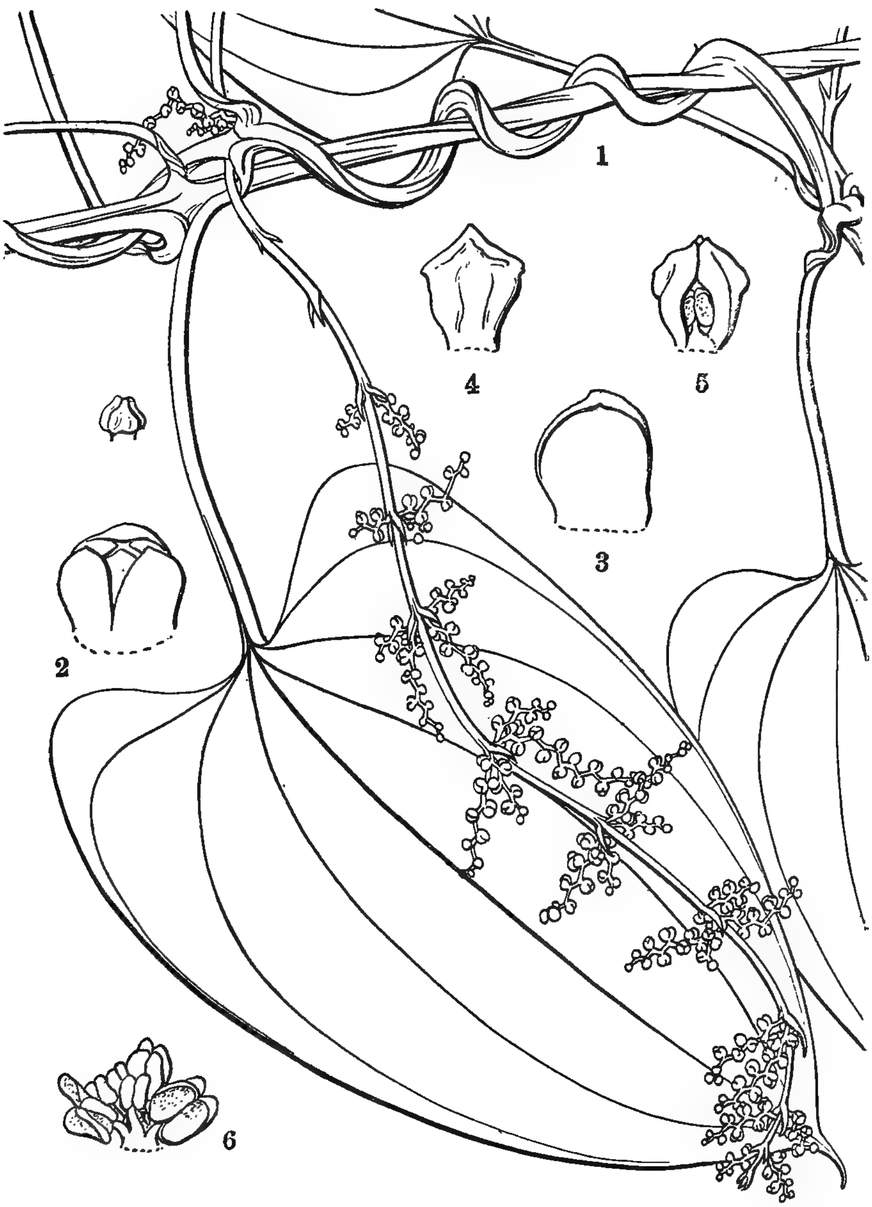

Fig. 23, *Dioscorea raishænsis* HAYATA; 1, a branch; 2, a male flower; 3, an outer sepal; 4, an inner sepal, seen from without; 5, the same, seen from within; 6, a cluster of stamens.

Fig. 24, *Dioscorea sativa* LINN.; 1, a branch; 2, a male inflorescence; 3, a male flower; 4 the same, partly taken off; 5, a stamen, seen from different sides; 6, a female flower; 7, stigmata.

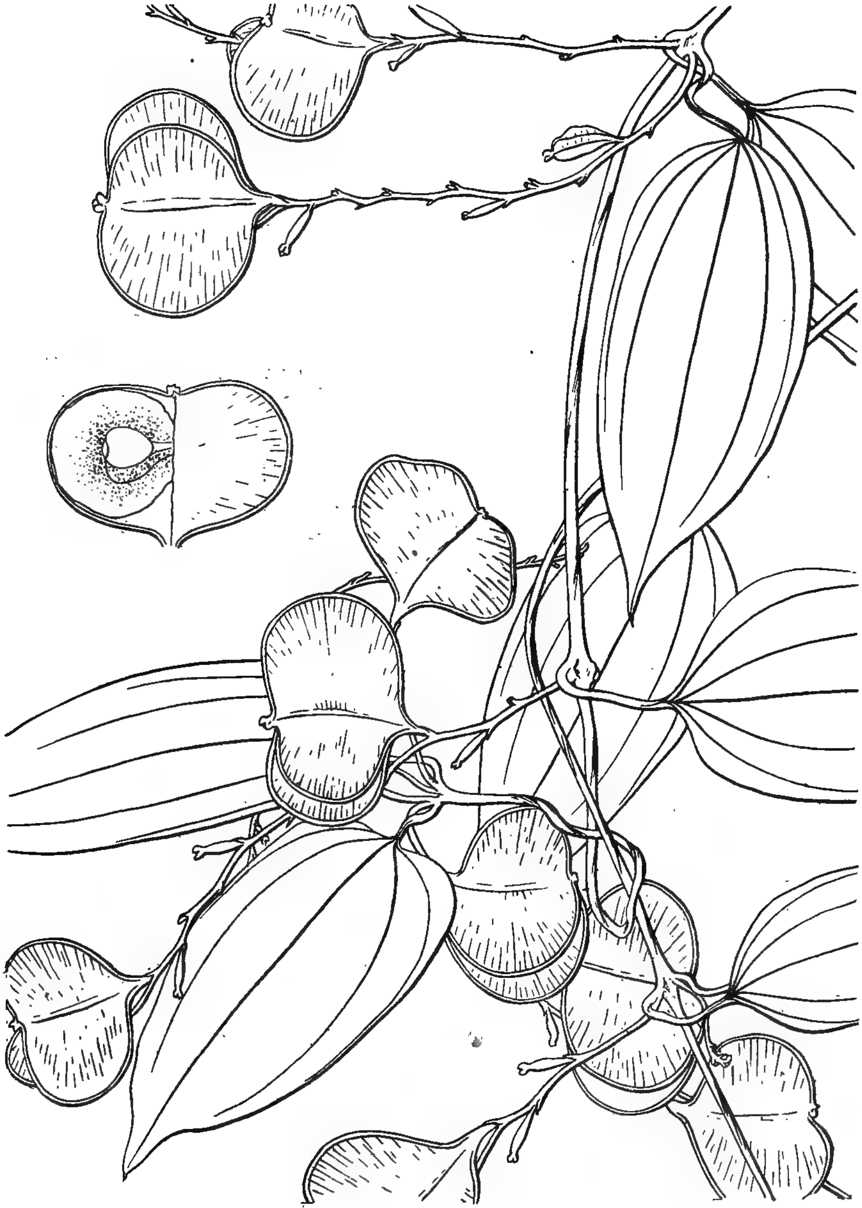

Fig. 25, *Dioscorea tarokœnsis* HAYATA.

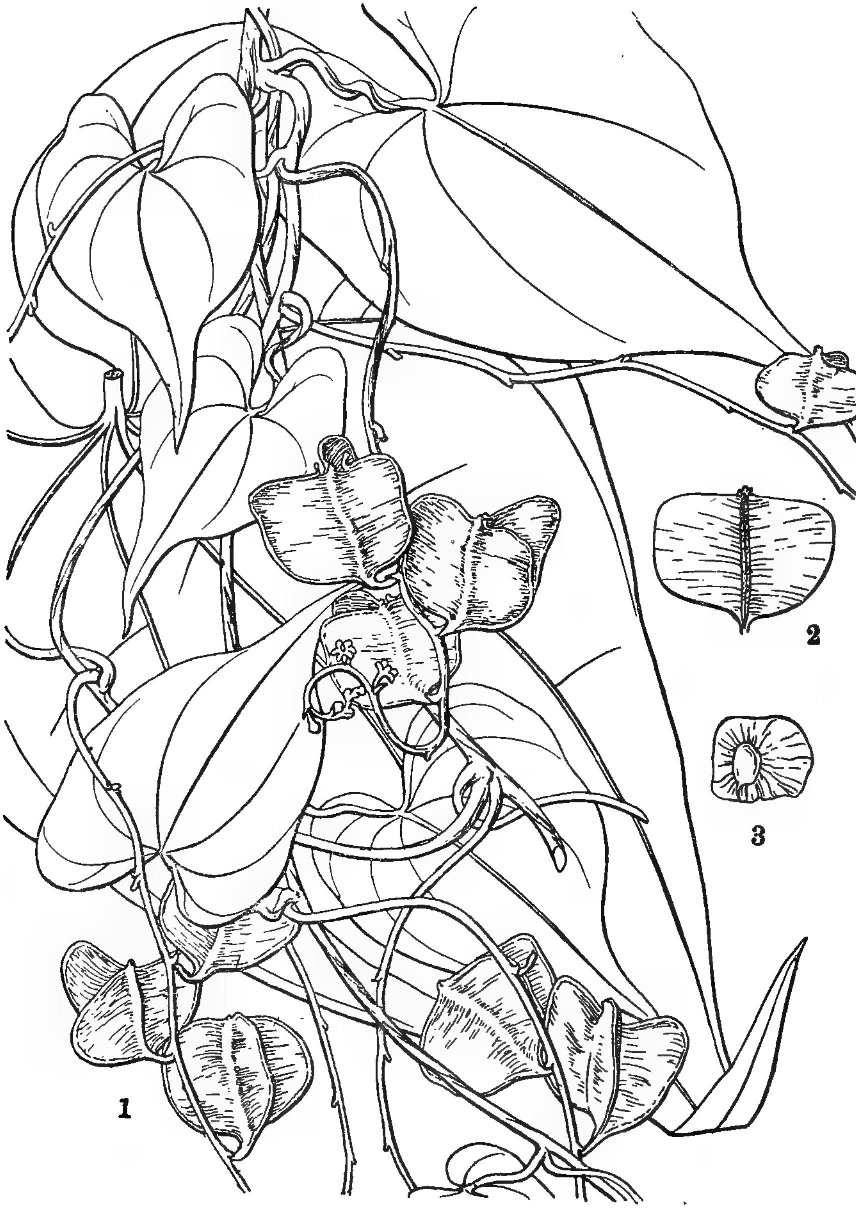

Fig. 26, *Dioscorea Tashiroi* Hayata; 1, a branch; 2, a capsule; 3, a seed.

5–10 cm. lata apice cuspidato-acuminata vel acuminatissima basi profunde cordata vel auriculato-cordata margine subintegra 7–nervia, petiolis gracillimis 8–15 cm. longis glabris. Racemi fructiferi 20–30 cm. longi. Capsula 3–quetra, angulis alæformibus quadrangularibus vel obtriangularibus apice truncatis basi rotundatis 12 mm. latis 15 mm. longis, valvis coriaceis. Semina valde compressa circumcirca ala membranacea cincta cum alis angulato-rotundata 13 mm. in diametro.

HAB. Kōtōshō, leg. Y. TASHIRO, Aug. 1912.

Near *Dioscorea japonica*, but differs from it in the rather angular capsules.

Eriocauleæ.

Eriocaulon LINN.

Eriocaulon formosanum HAYATA sp. nov. (Fig. 27). Folia cæspitosa 4–8 cm. longa medio 1–2 mm. lata glabra apice acuminata. Scapi 6–15 cm. longi gracillimi glabri basi 1–vaginati, vaginis glabris 1–2 cm. longis, oribus obliquissimis apice 2–lobatis vel 2–fidis glabris. Capitulum semi-globosum 3 mm. longum 4 mm. latum, bracteis involucralibus obovatis 2 mm. longis totiusque latis apice rotundatis basi plus minus angustatis utraque glabris concavis. Fl. ♂ et ♀ intermixti; bracteis oblanceolatis glabris $2\frac{1}{2}$ mm. longis $\frac{2}{3}$ mm. latis apice acutis vel acuminatis basi attenuatis. Fl. ♂: sepala in spathulam 2 mm. longam recurvam $\frac{2}{3}$ mm. latam anteriore fissam apice nigricantem 3–lobatam basi ad stipitem attenuatam apice hirsutam connata; corollæ tubus longus $1\frac{1}{2}$ mm. longus stipitiformis apice dilatatus 3–lobatus, lobis angustatis hirsutis $\frac{1}{4}$ mm. longis medio dorso 1–punctatis, punctis nigricantibus; staminibus 3–6, filamentis glabris, antheris flavescentibus reniformibus. Fl. ♀: sepala 2 filiformia basi cum stipite ovarii connata cæterum libera medio longe barbata, partibus liberis 1 mm. longis filiformibus; corolla basi ovarii in globulos minutos reducta. Ovarium longe stipitatum ovoideum trisulcatum, stipite $\frac{2}{3}$ mm. longo, stylo filiformi $1\frac{1}{2}$ mm. longo apice 2–fido. Receptaculum longe barbatum. Semina oblique ellipsoidea apice breve apiculata 7–8–striata.

HAB. Kinpori, Akōten, Suibishō, Sōaton, Unsuikei, Tōyen, Koteishō Taihoku.

Near *Eriocaulon Sieboldianum,* but distinguishable from it in having ciliolate sepals, ciliolate corolla-lobes and in the smaller seeds.

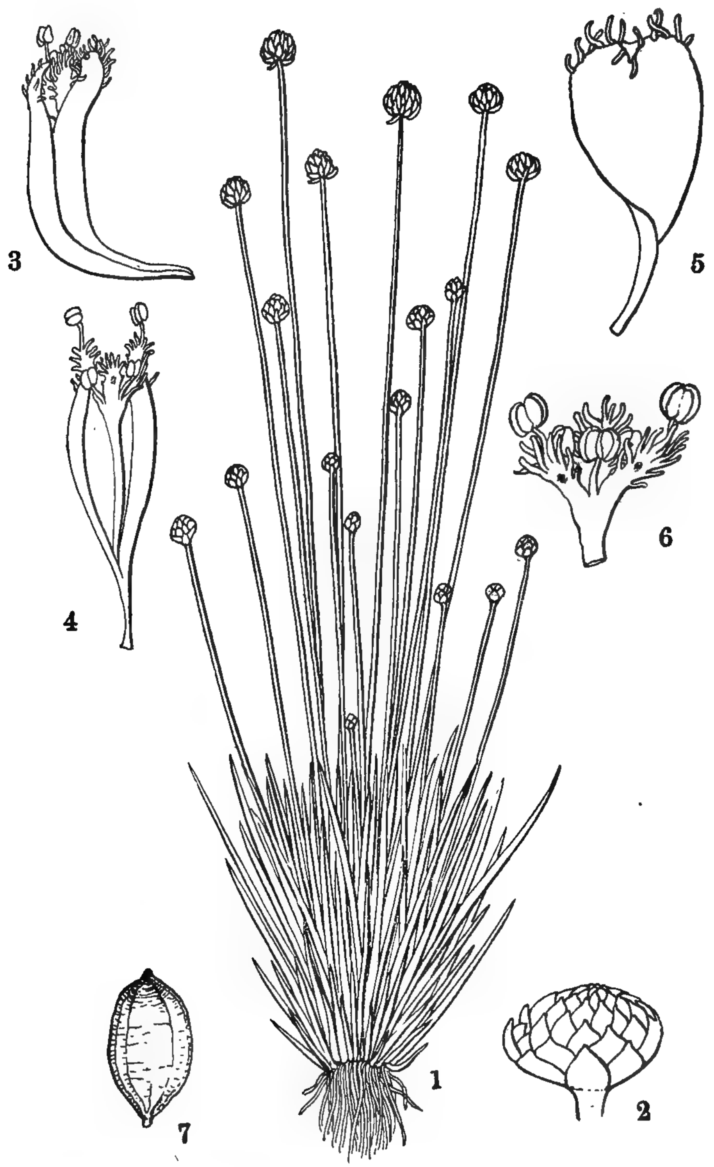

Fig. 27, *Eriocaulon formosanum* HAYATA; 1, the plant; 2, a head; 3, a male flower, seen from side; 4, the same, seen from front; 5, spathulate calyx; 6, apical portion of corolla with stamens; 7, a seed.

Eriocaulon nantœnse Hayata sp. nov. (Fig. 28). Folia cæspitosa linearia 3–4 cm. longa medio 3 mm. lata apice acuminata glaberrima erecta. Scapi cæspitosi 15–25 cm. longi glabri gracillimi 4–5-sulcati basi 1-vaginati, vaginis folia in longitudine fere æquantibus glabris 2–4 cm. longis, oribus oblique fissis apice obtusis. Capitulum late globosum 5 mm. longum 6 mm. latum, bracteis involucralibus majoribus obovatis 3 mm. longis 2 mm. latis apice rotundatis basi cuneatis glabris sterilibus, bracteis superioribus florem ♀ amplectantibus; bracteis inferioribus flores ♂ amplectantibus spathulatis $2\frac{1}{2}$ mm. longis $\frac{2}{3}$ mm. latis apice acutis vel triangulari-cuspidatis margine ciliolatis dorso hirsutis intus glabris. Fl. ♂: sepala 3 in spathulam interiore recurvam $2\frac{1}{2}$ mm. longam anteriore fissam apice 3-lobatam dorso apiceque ciliatam nigricantem apice $\frac{2}{3}$ mm. latam basi attenuatam connata; corollæ tubus 2 mm. longus gracilis, lobis 3 linearibus $\frac{1}{2}$–$\frac{2}{3}$ mm. longis albo-ciliatis $\frac{1}{4}$ mm. latis; stamina 3–6, antheris nigris. Fl. ♀: stipitati, stipitibus $\frac{1}{3}$ mm. longis: sepala 3 nigricantia spathulata 2 mm. longa $\frac{1}{2}$ mm. lata apice obtusa sursum margine dorsoque albo-ciliolata; corollæ tubus brevissimus

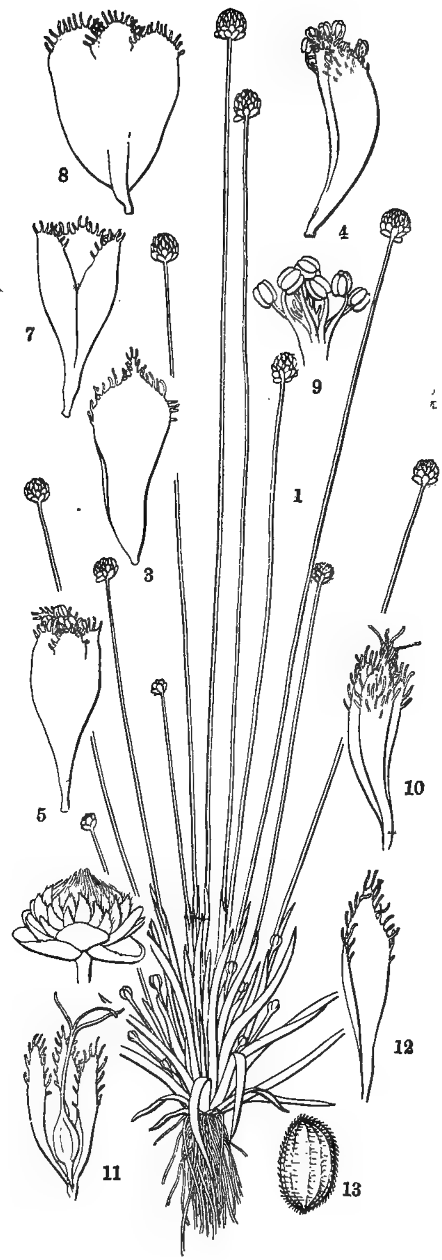

Fig. 28, *Eriocaulon nantœnse* Hayata; 1, the plant $\times \frac{3}{4}$; 2, a head; 3, a bract of a male flower; 4, 5, male flowers; 7, calyx of a male flower; 8, the same, more or less expanded; 9, apical portion of corolla with stamens; 10, a female flower; 11, the same, calyx taken off; 12, a petal; 13, a seed.

$\frac{1}{2}$ mm. longus gracilis, lobis 3 lineari-spathulatis $1\frac{1}{2}$ mm. longis $\frac{1}{6}$ mm. latis apice acutis sursum margine dorsoque albo-ciliolatis. Ovarium depresso-globosum $\frac{1}{2}$ mm. in diametro glabrum 3–sulcatum brevissime stipitatum, stylo $\frac{2}{3}$ mm. longo apice 3–fido, segmentis $\frac{1}{2}$ mm. longis glabris. Semina ovata $\frac{1}{2}$ mm. longa $\frac{1}{4}$ mm. lata apice acuta basi truncata longitudinaliter striata obscure reticulata minute muricato-echinata.

HAB. Nantō, leg. T. KAWAKAMI, 1913.

NOTE: Involucral bracts glabrous; receptacle densely barbate.

Near *Eriocaulon parvum* KOERN.; but differs from it in the much broader leaves.

Eriocaulon pachypetalum HAYATA sp. nov. (Fig. 29). Folia cæspitosa 6–12 cm. longa linearia medio 4 mm. lata apice acuminata utraque glabra. Scapi cæspitosi 10–18 cm. longi 4–5–sulcati glabri folia in longitudine paulo superantes basi 1–vaginati, vaginis 4 cm. longis glabris, oribus truncatis latere uno fissis. Capitulum depresso-globosum 3–4 mm. longum 6 mm. latum, bracteis involucralibus obovatis $2\frac{1}{2}$ mm. longis $1\frac{2}{3}$ mm. latis apice obtusissimis. Fl. ♂ et ♀ intermixti. Fl. ♂: bracteis obovato-cuneatis 3 mm. longis $1\frac{1}{2}$ mm. latis apice acutis vel cuspidato-acutis basi angustatis intus glabris extus sursum dense pulveraceis; sepala in spathulam 2 mm. longam 1 mm. latam apice rotundatam brevissime 3–lobulatam dorso sursum dense pulveraceam et ciliolatam basi cuneatam ad stipitem 1 mm. longum abeuntem connata; corollæ tubus gracillimus $1\frac{1}{2}$ mm. longus apice crassissimus trilobatus, lobis incrassatis triangularibus $\frac{1}{3}$ mm. longis $\frac{1}{4}$ mm. latis acutis glabris; stamina 6–3, filamentis glabris $\frac{1}{2}$ mm. longis basi incrassatis, antheris nigricantibus. Fl. ♀: sepala 2 oblonga 2 mm. longa 1 mm. lata secus longitudine plicata apice obtusa ciliolata pulveracea; petala 3 distincta spathulata 2 mm. longa $\frac{1}{2}$ mm. lata apice obtusa cristata ad apicem glandula nigra punctata basi attenuata ad stipitem abeuntia toto incrassata. Ovarium ovoideum $\frac{2}{3}$ mm. longum $\frac{1}{2}$ mm. latum glabrum 3–sulcatum.

HAB. Tōyenchō: Taikokan, Tōyen; Daigyorin, leg. Y. SHIMADA, Oct. 1914.

Near *Eriocaulon alpestre*, but differs from it in the much incrassate corolla-lobes of male flowers.

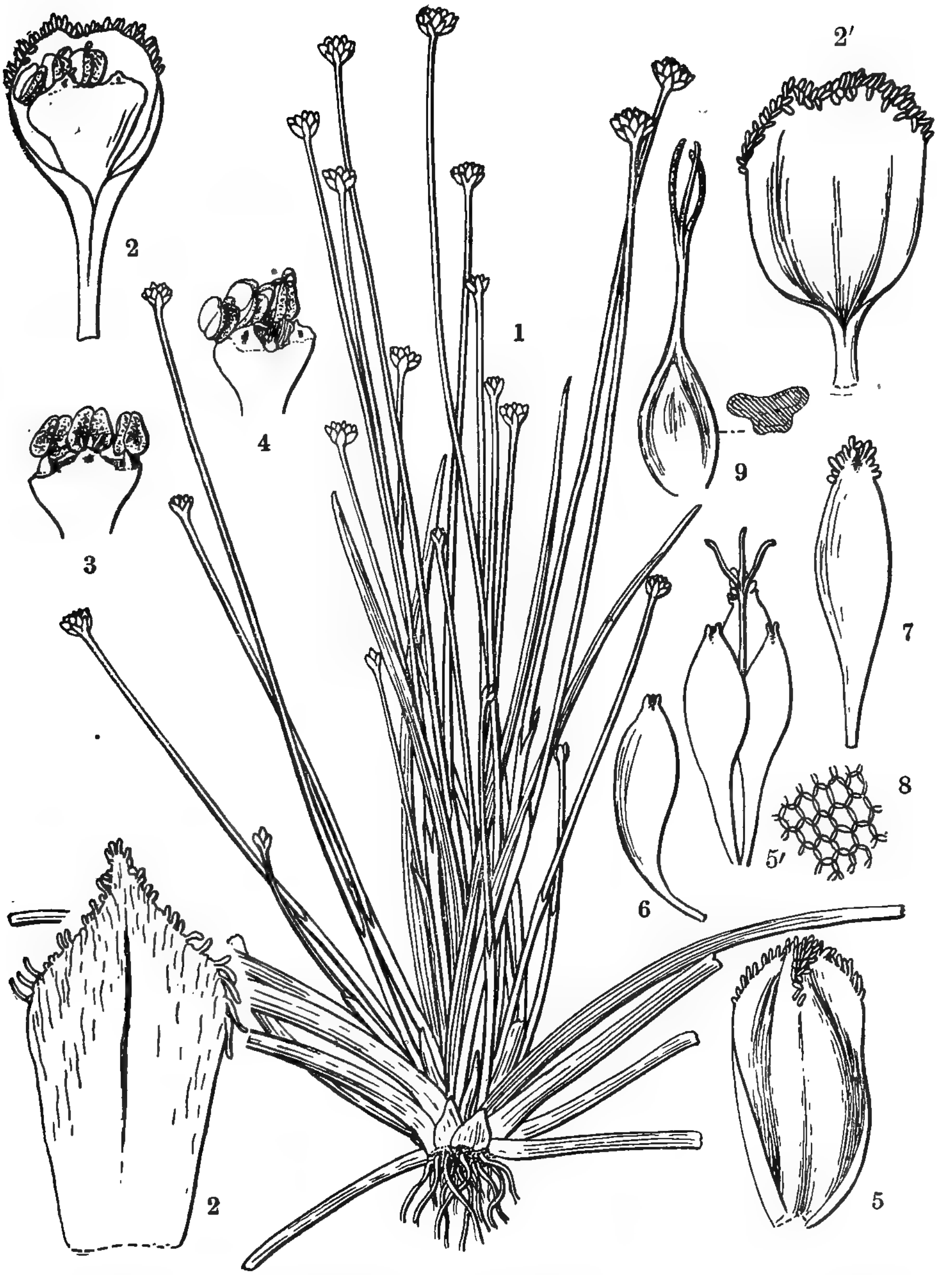

Fig. 29, *Eriocaulon pachypetalum* HAYATA; 1, the plant; 2, a male flower; 2′, a spathulate calyx of the same flower; 3, apical portion of a male corolla; 4, the same; 5, a female calyx; 5′, a female flower, calyx taken off; 6, a petal; 7, another petal; 8, groups of cells on the surface of the same; 9, ovary.

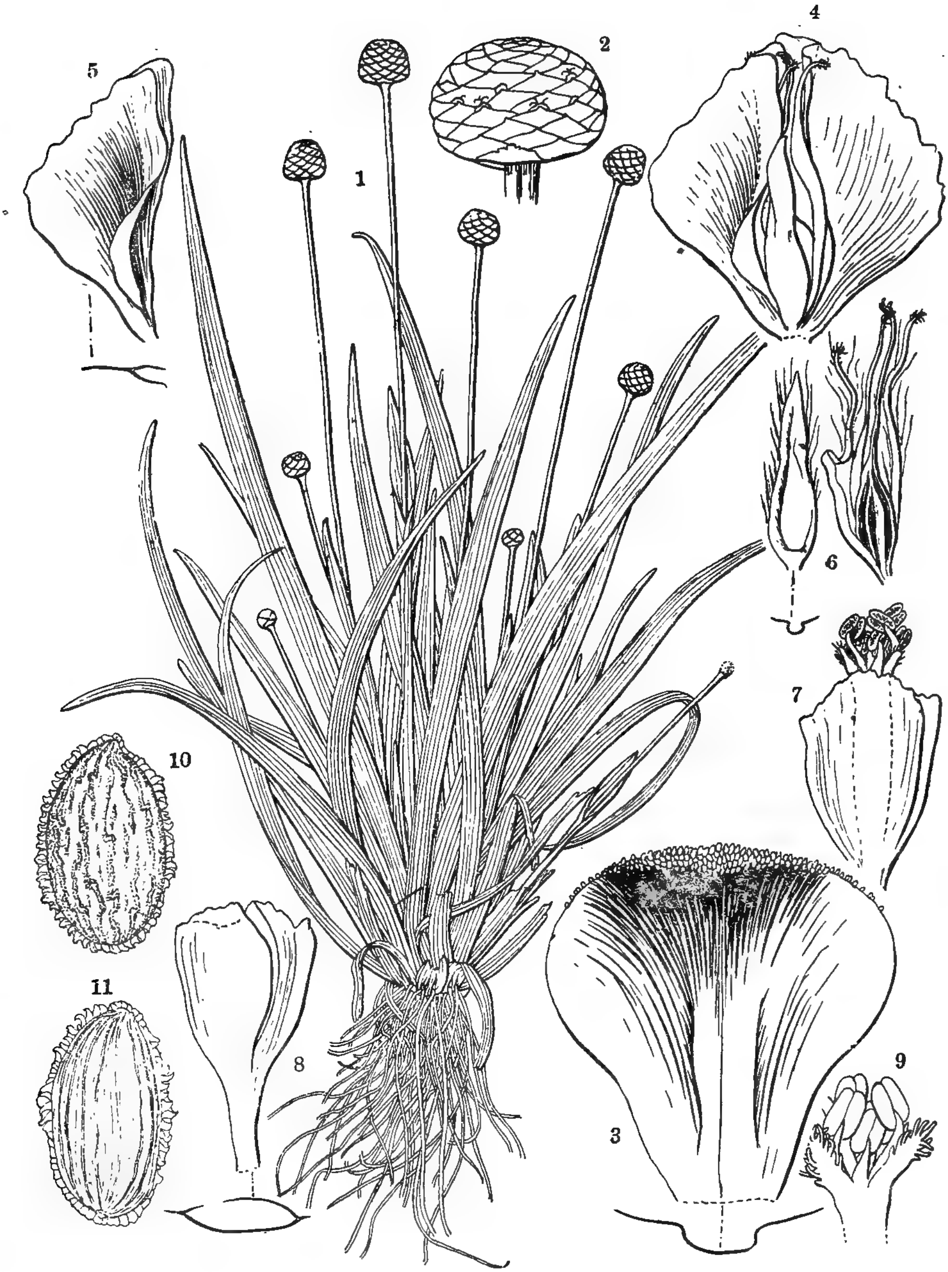

Fig. 30, *Eriocaulon pterosepalum* HAYATA; 1, the plant $\times\frac{5}{7}$; 2, a head; 3, a bract; 4, a female flower; 5, a sepal; 6, a male flower; 8, tubiform calyx; 9, apical portion of corolla with stamens; 10, 11, seeds with different markings.

NOTE: Receptacle densely barbate; bracts and sepals barbate at the base

Eriocaulon petrosepalum HAYATA sp. nov. (Fig. 30). Folia cæspitosa linearia 7–20 cm. longa 3–6 mm. lata apice acuminata utraque glabra. Scapi cæspitosi in longitudine folia æquantes vel superantes glabri 10–20 cm. longi basi 1–vaginati, vaginis 5–7 cm. longis sursum prope apicem fissis apice obtusis glabris. Capitulum depresso- vel elongato-globosum 4–6 mm. longum 5 mm. latum glabrum, bracteis involucralibus depresso-rotundatis obovatis vel ovatis $2\frac{1}{2}$ mm. longis totiusque latis apice rotundatis valde concavis margine integris vel denticulatis. Fl. ♂ et Fl. ♀ intermixti; bracteis cuneatis sursum subito incurvis, inferioribus latioribus $2\frac{1}{2}$ mm. longis 2–$2\frac{1}{2}$ mm. latis intus glabris extus sursum pulveraceis apice truncatis ad centrum brevissime cuspidatis. Fl. ♂: sepala 2 in spathulam obtriangularem 2 mm. longam 1 mm. latam latere alatam anteriore fissam apice truncatam erosam basi angustissime cuneatam glabram connata; alis spathularum angustissimis $\frac{1}{8}$ mm. latis; corollæ tubus $1\frac{1}{2}$ mm. longus glaber angustissimus basi filiformis apice dilatatus 3–lobatus, lobis linearibus $\frac{1}{2}$ mm. longis apice sursum ciliolatis pauce hirsutis; stamina 3–6, antheris nigricantibus. Fl ♀: sepala 2 late alata cum alis semi-rhombica 2 mm. longa 1 mm. lata apice acuta vel obtusa basi acuta vel obtusa glabra, alis $\frac{1}{2}$ mm. latis incrassatis margine serrulatis; petala 3 spathulato-linearia $1\frac{1}{2}$ mm. longa $\frac{1}{4}$ mm. lata margine longe barbata. Semen ovoideum $\frac{2}{3}$ mm. longum $\frac{1}{4}$ mm. latum longitudinaliter striatum minute muricatum.

HAB. Tōyenchō: Daitikuishō (typus!), Hakketsu, Hokuto.

Near *Eriocaulon truncatum* BUCH.-HAM.; but differs from it in the semi-rhombic sepals.

Eriocaulon suishænse HAYATA sp. nov. (Fig. 31). Folia cæspitosa linearia 3–4 cm. longa 3 mm. lata apice acuminata glabra. Scapi cæspitosi 3–15 cm. longi glabri 4–5–sulcati basi 2–vaginati, vaginis folium in longitudine æquantibus 3–4 cm. longis, oribus obliquissimis apice acutis glabris. Capitulum depresso-globosum 4 mm. in diametro $2\frac{1}{2}$ mm. longum; bracteis involucralibus obovatis $2\frac{1}{2}$ mm. longis $2\frac{2}{3}$ mm. latis apice rotundatis serrulatis basi angustioribus glaberrimis; bracteis exterioribus sterilibus, interioribus fertilibus obovatis hyalinis valde concavis $1\frac{1}{2}$–2 mm. longis $1\frac{1}{2}$ mm. latis apice latis truncatis

denticulatis. Flores ♂ et ♀ intermixti. Fl ♂: sepala in spathulam $1\frac{1}{2}$ mm. longam $\frac{2}{3}$ mm. latam apice truncatam margine erosam anteriore fissam basi ad stipitem attenüatam glabram connata; corollæ tubus longus sepala æquans glaber, lobis 3 lanceolatis apice hirsutis $\frac{1}{4}$ mm. longis; staminibus 6, antheris nigricantibus. Fl. ♀: sepala 2 distincta linearia $1\frac{1}{4}$ mm. longa secus medium plicata $\frac{1}{4}$ mm. lata; petala 3 basi plus minus connata spathulato-linearia 1 mm. longa $\frac{1}{8}$ mm. lata acuta apice paulo ciliolata. Ovarium depresso-ovoideum glabrum, stylo apice 3-fido. Semina ellipsoidea plus minus obliqua longitudinaliter elevato-striata apice obtusa basi truncata $\frac{1}{4}$ mm. longa.

HAB. Suisha, leg. B. HAYATA, Aprili. 1916, (typus!); Giran, Kōrishō, Taiton.

Fig. 31, *Eriocaulon suishœnse* HAYATA; 1, the plant; 1′, a head; 2, a male flower; 3, spathulate calyx; 4, apical portion of corolla; 5, a female flower, sepals off; 6, a sepal; 7, a petal, more magnified; 8, a seed.

Near *E. alpestre* HK. f. et THOMS., but differs from it in the less incrassate petals of the female flowers.

NOTE: bracts usually glabrous; receptacle nearly glabrous.

Cyperaceæ.

Carex LINN.

Subgenus **Vignea** NEES.

Carex remotispicula HAYATA sp. nov. (Fig. 32). Caulis foliifer et spicifer 60–100 cm. longus erectus gracillimus basi vaginatus a basi sursum foliifer. Folia omnia caulina linearia 10–20 cm. longa supra margineque scaberrima apice acuminata basi vaginiformia, superiora caulem valde superantia. Spicæ secus caulem superiorem spicatim dispositæ axillares solitariæ; spicis oblongo-ovoideis 11 mm. longis 5 mm. latis sessilibus androgynis, floribus inferioribus masculinis, superioribus fœmineis. Fl. ♂: ad basin spicæ 1–3-dispositi, squamis oblongis vel ovatis 3–4 mm. longis $1\frac{1}{2}$–2 mm. latis apice obtusis vel acutis dorso 1-costatis, staminibus 3. Fl. ♀: squamis oblongo-ovatis 3 mm. longis $1\frac{1}{2}$ mm. latis apice acutis vel obtusis basi truncatis medio 1-nerviis margine denticulatis. Utriculus ovato-lanceolatus 4 mm. longus $1\frac{1}{3}$ mm. latus apice acuminatus ore 2-dentatus 2-lateralis facie planus vel concavus dorso convexus glaber latere acute costatus ad latus hirsutus. Nucula flava obovoidea complanata glabra $1\frac{2}{3}$ mm. longa 1 mm. lata apice rotundata basi acuta vel obtusa.

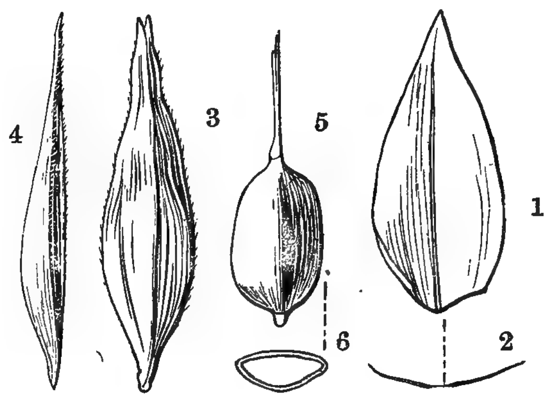

Fig. 32, *Carex remotispicula* HAYATA; 1, a scale; 2, section of the same; 3, an utricle; 4, the same, seen from side; 5, an utlet; 6, section of the same.

HAB. Arisan, ad 2500 ped. alt., leg. U. FAURIE, Jun. 1914.

Near *Carex lagopina* WAHLENB.

Subgenus **Eucarex** Coss. et Germ.

Sect *Acutæ.*

Carex pachinensis Hayata sp. nov. (Fig. 33). Folia fasciculata linearia 50–60 cm. longa 4–5 mm. lata apice acuminata margine scabriuscula. Caulis 80 cm. longus foliatus; spica ♂ terminalis cylindrica 3 cm. longa 5 mm. lata, pedunculo 4 cm. longo gracillimo; spicis ♀ lateralibus remote dispositis cylindricis 4 cm. longis 1 cm. latis, pedunculis gracillimis subpendulis 3–4 cm. longis. Fl. ♀: squamis imbricatis elongato-oblongis 5 mm. longis 2 mm. latis apice obtusis basi obtusis dorso 1–costatis margine denticulatis, costis brevioribus ad apicem squamæ haud attingentibus. Fl. ♀: squamis oblongo-ovatis $4\frac{1}{2}$ mm. longis $1\frac{1}{2}$ mm. latis apice obtusis apice denticulatis dorso 1–costatis. Utriculus ovoideo-fusiformis cum rostro 7 mm. longus 2 mm. latus bilateralis ad latus scaberrimus, rostro 2 mm. longo lineari recto apice 2–dentato. Nucula rhomboidea 2 mm. longa $1\frac{1}{3}$ mm. lata glabra rubra acute triquetra, stipite 1 mm. longo.

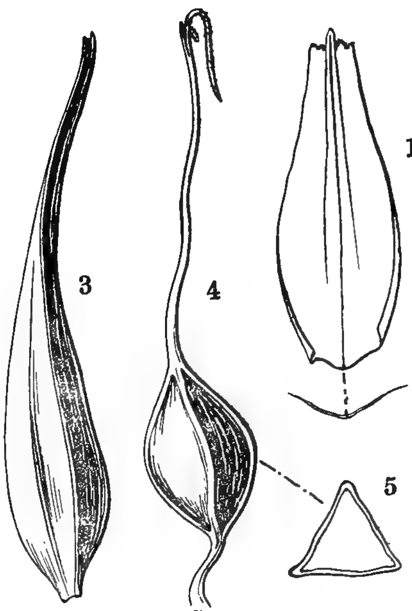

Fig. 33, *Carex pachinensis* Hayata; 1, a scale; 2, section of the same; 3, an utricle; 4, a nutlet; 5, section of the same.

Hab. Pachina, leg. U. Faurie.

Carex shichiseitensis Hayata sp. nov. (Fig. 34). Caulis 100–120 cm. longus foliifer. Folia radicalia et caulina linearia 100–120 cm. longa 5–6 mm. lata apice acuminata facie margineque glabra. Spicæ prope apicem caulis 3–5-dispositæ; spica ♂ terminalis solitaria cylindrica erecta vel plus minus pendula 5 cm. longa 2 mm. lata, pedunculo 1 cm. longo; spicis ♀ lateralibus pendulis alternis ad axillas foliorum superiorum dispositis foliis caulinis valde superatis cylindricis 5 cm. longis 3 mm. latis dense floriferis, pedunculis tenuissimis 2

cm. longis gracillimis pendulis. Fl. ♂: squamis oblanceolatis 4 mm. longis 1 mm. latis sursum rotundatis apice cuspidatis, cuspidibus 1 mm. longis latere serrulatis; stamina 3. Fl. ♀: squamis rotundato-obovatis $1\frac{1}{2}$ mm. longis 1 mm. latis sursum rotundatis vel sagittatis apice longe cuspidato-aristatis, aristis $1\frac{1}{2}$ mm. longis latere serrulatis. Utriculus rhomboideus ovatus 3 mm. longus $1\frac{1}{2}$ mm. latus valde complanatus fulvo-velutinosus latere costatus apice acutus breve rostratus, ore integro. Nucula rotundata valde complanata biconvexa $1\frac{1}{2}$ mm. longa totiusque lata apice abrupte ad stylum abeuns basi abrupte angustata brevissime stipitata vel sessilis glabra pallido-fulvescens.

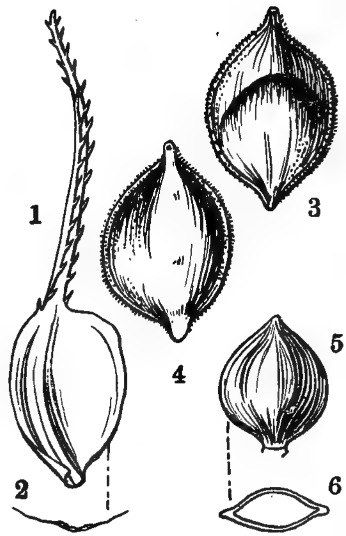

Fig. 34, *Carex shichiseitensis* HAYATA, 1, a scale; 2, section of the same; 3, 4, an utricle, seen from different sides; 5, a nutlet; 6, section of the same.

HAB. Shichiseitonzan, leg. Y. SHIMADA, Mai. 1918.

Near *Carex cincta* FRANCH.; but distinguishable from it in the much longer nodding female spikelets.

Carex taiheiensis HAYATA sp. nov. Caulis spicifer 20–30 cm. longus. Folia basi caulis et secus caulem disposita linearia coriaceo-membranacea caulem superantia 30 cm. longa 6 mm. lata apice acuminata basi longe vaginata margine costaque scabriuscula. Spica ♂ terminalis solitaria tenuissima breve pedunculata 3 cm. longa $1\frac{1}{2}$ mm. lata; spicis ♀ lateralibus tenuissimis superioribus spicam ♂ valde superantibus 6 cm. longis $2\frac{1}{2}$ mm. latis a medio caulis sursum 4–5–dispositis longe pedunculatis glabris. Fl. ♂: squamis spathulatis imbricatis 4 mm. longis apice acuminatis aristis $\frac{1}{2}$ mm. longis terminatis basi obtusis margine sursum denticulatis; stamina 2, filamentis longissimis, antheris oblongis 1 mm. longis $\frac{1}{3}$ mm. latis apice acutis. Fl. ♀: squamis oblongo-ovatis $2\frac{1}{2}$ mm. longis 1 mm. latis apice acuminatis 1–costatis apice plus minus hirsutis. Utriculus ovoideo-fusiformis $2\frac{1}{2}$ mm. longus $\frac{2}{3}$ mm. latus dense hirsutus

apice attenuatus 2-dentatus plus minus complanatus latere costatus. Nucula ignota.

Near *Carex incisa* BOOTT.; but differs from it in the acuminate scales of the female flowers.

HAB. Taiheizan: Tabō, leg. B. HAYATA et S. SASAKI, Mai. 1917.

Carex uraiensis HAYATA sp. nov. (Fig. 35). Folia fasciculata linearia 60 cm. longa 6–8 mm. lata apice acuminata pallido-viridia supra opaca margine costa facieque scabriuscula. Caulis spicifer 40 cm. longus 3–4-foliatus, foliis caulinis minoribus. Spica ♂ terminalis solitaria cylindrica $3\frac{1}{2}$ cm. longa 4 mm. lata apice obtusa longe pedunculata; spicis lateralibus androgynis cylindricis $3\frac{1}{2}$ cm. longis longe pedunculatis, floribus ♂ superioribus, floribus ♀ inferioribus. Fl. ♂: squamis valde imbricatis elongato-oblongis 4 mm. longis $1\frac{1}{2}$ mm. latis sursum obtusis vel emarginatis apice arista $\frac{1}{4}$ mm. lata $\frac{2}{3}$ mm. longa instructis. Fl. ♀: squamis imbricatis ovatis 2 mm. longis $1\frac{1}{3}$ mm. latis sursum obtusis apice arista $\frac{1}{2}$ mm. longa instructis. Utriculus ovoideo-fusiformis 3 mm. longus 1 mm. latus hirsutus apice rostratus 2-dentatus triquetrus. Nucula ovoideo-rhomboidea triquetra nigrissima apice basique subalba apice colli-formis truncata basi breve stipitata facie excavato-impressa.

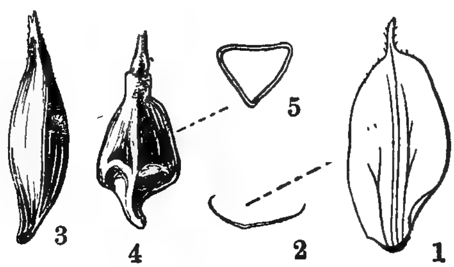

Fig. 35, *Carex uraiensis* HAYATA; 1, a scale; 2, section of the same; 3, an utricle; 4, a nutlet; 5, section of the same.

HAB. Urai, leg. B. HAYATA, Mai. 1916.

Note: Leaves pale-green dull above.

Sect. *Maximæ*.

Carex maculata BOOTT. HAYATA (Fig. 36). Ic. Pl. Formos. VI. p. 124.

HAB. Shichiseitonzan, leg. Y. SHIMADA.

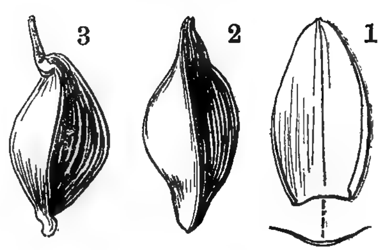

Fig. 36, *Carex maculata* BOOTT.; 1, a scale; 2, an utricle; 3, nutlet.

Sect. *Mitratæ.*

Carex cryptostachys BRONGN. (Fig. 37); KÜKENTHAL, Cyperaceæ-Caricoideæ in das Pflanzenreich IV–20, p. 471.

HAB. Kelung, leg. U. FAURIE, Mart. 1914, No. 6.

NOTE: Spicules bisexual.

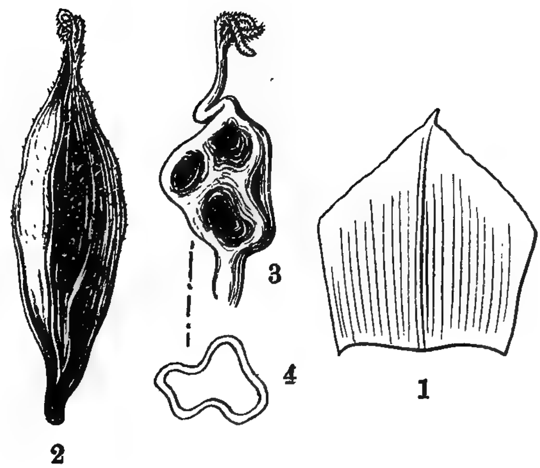

Fig. 37, *Carex cryptostachys* BRONGN.; 1, a scale; 2, an utricle; 3, a nutlet; 4, section of the same.

Carex daibuensis HAYATA sp. nov. Folia fasciculata validiuscula linearia 50–60 cm. longa 4–5 mm. lata apice acuminata margine scaberrima. Caulis spicifer 20–25 cm. longus tenuissimus foliis caulinis minoribus instructus. Spica terminalis masculina erecta pedunculata longissima 3–4 cm. longa $1\frac{1}{2}$ mm. lata; spicis lateralibus fœmineis $1\frac{1}{2}$ cm. longis 2 mm. latis secus caulem superiorem 2–3 dispositis breve pedunculatis. Fl. ♂: squamis oblongis 4 mm. longis 2 mm. latis apice obtusis; stamina 3, filamentis longissimis. Fl. ♀: squamis rotundatis 2 mm. longis totiusque latis apice breve cuspidatis. Utriculus hirsutus ovoideo-fusiformis 3 mm. longus 1 mm latus apice longe attenuatus basi obtusus obliquus apice oblique 2-lobatus. Nucula matura ignota.

HAB. Daibusan, leg. Y. MATSUDA.

Near *Carex foliosissima* FRANCH.

Carex dolichostachya HAYATA sp. nov. (Fig. 38). Folia fasciculata linearia 60 cm. longa 1 cm. lata apice acuminata margine scabra. Caulis 30–60 cm. longus efoliatus squamatus, squamis basi vaginiformibus, vaginis 4 cm. longis apice laminiferis, laminis linearibus 5 cm. longis. Spica ♂ terminalis longe cylindrica 2 cm. longa 2 mm. lata erecta longe pedunculata; spicis ♀: lateralibus secus caulem 4–5 dispositis tenuissimis 6–7 cm. longis 2–3 mm. latis. Fl. ♂: squamis oblanceolatis 6 mm. longis 2 mm. latis apice obtusis vel

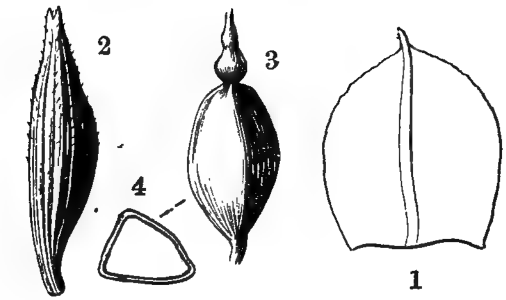

Fig. 38, *Carex dolichostachya* HAYATA; 1, a scale; 2, an utricle; 3, a nutlet; 4, section of the same.

acutis sursum denticulatis; staminibus 3, filamentis longe exsertis, antheris linearibus 4 mm. longis $\frac{1}{2}$ mm. latis apice acute apiculatis. Fl. ♀: squamis oblongis 3 mm. longis 2 mm. latis apice obtusis apiculatis 1-costatis. Utriculus fusiformis $3\frac{1}{2}$ mm. longus 1 mm. latus hirsutus apice attenuatus apice 2-dentatus basi attenuatus plus minus triquetrus. Nucula castanea 2 mm. longa 1 mm. lata glabra triquetra ovoidea apice infra apicem constricta basi ad stipitem $\frac{1}{2}$ mm. longum attenuata.

HAB. Sharyōtō, Kelung, Shichiseizan, Remogan, Senzanko.

Near *Carex foliosissima* FRANCH.

Carex gracilispica HAYATA sp. nov. (Fig. 39). Folia fasciculata linearia 60 cm. longa 1 cm. lata apice acuminata herbaceo-membranacea pallido-viridia margine scabrida. Caulis spicifer tenuissimus gracillimus 30 cm. longus foliis minutis instructus; spicis secus caulem dispositis. Spica ♂ terminalis solitaria erecta tenuissima sessilis $1\frac{1}{2}$ cm. longa 1 mm. lata; spicis ♀ lateralibus longioribus spicam masculinam valde superantibus cylindricis 5 cm. longis 3 mm. latis pedunculatis. Fl. ♂: squamis convolutis valde

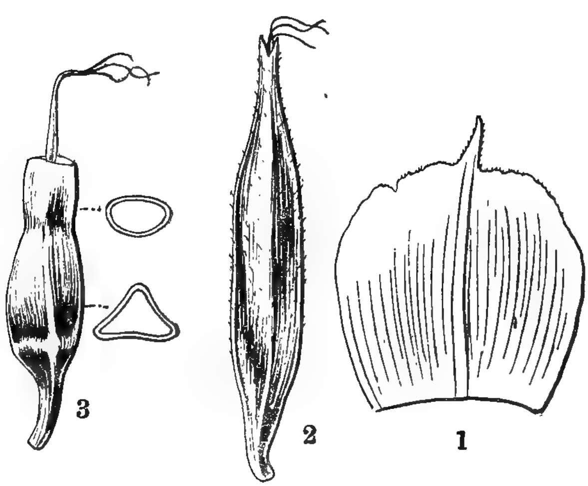

Fig. 39, *Carex gracilispica* HAYATA; 1, a scale; 2, an utricle; 3, a nutlet.

imbricatis 3 mm. longis 2 mm. latis ovatis apice rotundatis ad centrum aristatis, aristis $\frac{1}{5}$ mm. longis, 1-nerviis. Stamina 3, filamentis 3 mm. longis valde complanatis. Fl. ♀ : squamis rotundato-ovatis basi rhacheolam amplectantibus 3 mm. longis $2\frac{1}{2}$ mm. latis apice aristatis. Utriculus triquetrus ovoideo-fusiformis hirsutus 4 mm. longus 1 mm. latus apice attenuatus basi obtusus apice 2-dentatus. Nucula cylindrico-ovoidea $2\frac{1}{2}$ mm. longa $\frac{2}{3}$ mm. lata apice colliformis truncata basi acuta ad stipitem $\frac{1}{2}$ mm. longum abeuns fuscens tri-costata, colla $\frac{1}{2}$ mm. longa $\frac{1}{3}$ mm. lata.

HAB. Hōōzan, leg. B. HAYATA, Aprili. 1916.

Near *Carex ligata* BOOTT., but greatly differs from it in the much larger leaves and in the aristate scales of male and female flowers

NOTE : Utricles and glumes pale-green ; leaves fresh-green, soft in texture.

Carex kelungensis HAYATA sp. nov. (Fig. 40). Folia fasciculata linearia 40–50 cm. longa 4–5 mm. lata apice acuminata margine scabrida. Caulis spicifer 40–50 cm. longus tenuissimus, foliis caulinis valde minoribus linearibus 10-15 cm. longis $2\frac{1}{2}$ mm. latis. Spica ♂ terminalis pedunculata cylindrica tenuissima 2 cm. longa $1\frac{1}{2}$ mm. lata erecta solitaria ; spicis lateralibus fœmineis erectis cylindricis tenuissimis 3 cm. longis 2 mm. latis. Fl. ♂ : squamis oblongis 6 mm. longis $2\frac{1}{2}$ mm. latis apice obtusis, staminibus 3. Fl. ♀ : squamis oblongis vel ovatis $3\frac{1}{2}$ mm. longis $1\frac{1}{2}$ mm. latis dorso 1-costatis, costis viridibus, apice obtusis et breve aristatis margine minute hirsutis. Utriculus fusiformis $4\frac{1}{2}$ mm. longus 1 mm. latus apice basique attenuatus plus minus triquetrus tenuiter hirsutus vel subglaber. Nucula 3–$2\frac{1}{2}$ mm. longa 1 mm. lata apice colli-formis truncata basi attenuata ad stipitem $\frac{1}{2}$ mm. longum abeuns pallido-flava.

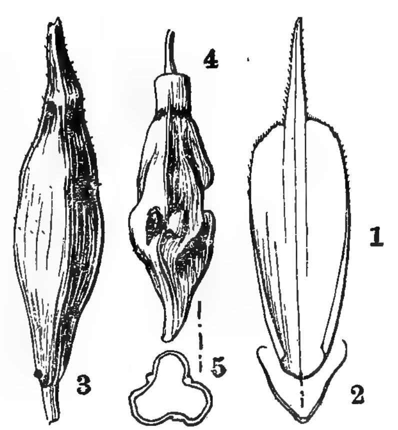

Fig. 40, *Carex kelungensis* HAYATA ; 1, a scale ; 2, section of the same ; 3, an utricle ; 4, a nutlet ; 5, section of the same.

HAB. Kelung.

Near *Carex ligata* BOOTT., but differs from it in the long mucronate (or

rather aristate) scales of the female spikelets.

Carex ligata BOOTT. in BENTH. Fl. Hongk. p. 402; KÜKENTH. in ENGL. Pfl-reich, Cyper.-Caric. p. 473; var. **formosensis** (LÉV. et VAN.) KÜKENTH. l.c. p. 474. *Carex formosensis* LÉV. et VAN. in Mém. Soc. sc. nat. Cherbourg XXXV. p. 216.

HAB. Kelung, leg. U. FAURIE (ex KÜKENTH.)

Carex Morii HAYATA Ic. Pl. Formos. VI. p. 135. Folia fasciculata validissima 100–120 cm. longa 14–15 mm. lata apice acuminata coriacea facie margineque glabra. Caulis spicifer 3–4-foliatus 100–200 cm. longus 2–3-foliatus triquetrus.

HAB. Rankanzan, ad 4000 ped. alt., leg. B. HAYATA, Mai, 1916; Buizan, leg. Y. MATSUDA, Juli. 1918.

Somewhat comparable to *Carex Reinii* FR. et. SAV.

Carex rankanensis HAYATA sp. nov. (Fig. 41). Folia fasciculata linearia 60–100 cm. longa 7–8 mm. lata margine scabriuscula basi squamis purpureis instructa. Caulis spicifer tenuissimus gracillimus 50 cm. longus foliis valde minoribus 2–3 instructus. Spica ♂ terminalis longissima tenuissima solitaria 5–7 cm. longa 1–2 mm. lata longe pedunculata; spicis ♀ lateralibus tenuissimis 3–4 cm. longis 2 mm. latis pedunculatis prope apicem caulis 2–3-dispositis. Fl. ♂: squamis oblanceolatis 6 mm. longis $2\frac{1}{2}$ mm. latis apice obtusis basi rhacheolam amplectantibus, antheris 3 linearibus $2\frac{1}{2}$ mm. longis $\frac{1}{8}$ mm. latis. Fl. ♀: squamis ovatis 3 mm. longis $1\frac{1}{2}$ mm. latis acutis 1-costatis glabris. Utriculus fusiformis 3 mm. longus $\frac{2}{3}$ mm. latus apice obtusus 2-dentatus basi attenuatus dense hirsutus. Nucula triquetra longe stipitata matura ignota.

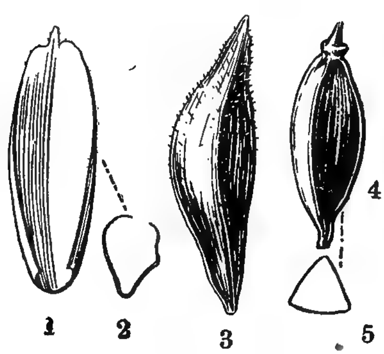

Fig. 41, *Carex rankanensis* HAYATA; 1, a scale; 2, section of the same; 3, an utricle; 4, a nutlet; 5, section of the same.

HAB. Rankanzan, leg. B. HAYATA, ad 4000 ped. alt., Mai. 1916.

Near *Carex foliosissima* FRANCH.; but differs from it in the much slenderer female spikelets.

Sect. ***Frigidæ.***

Carex gokwanensis Hayata sp. nov. (Fig. 42). Caulis 8–10 cm. longus foliis basi fasciculatim instructus. Folia linearia validiuscula 10–15 cm. longa 3 mm. lata apice acuminata basi vaginiformia supra margineque scabra subtus

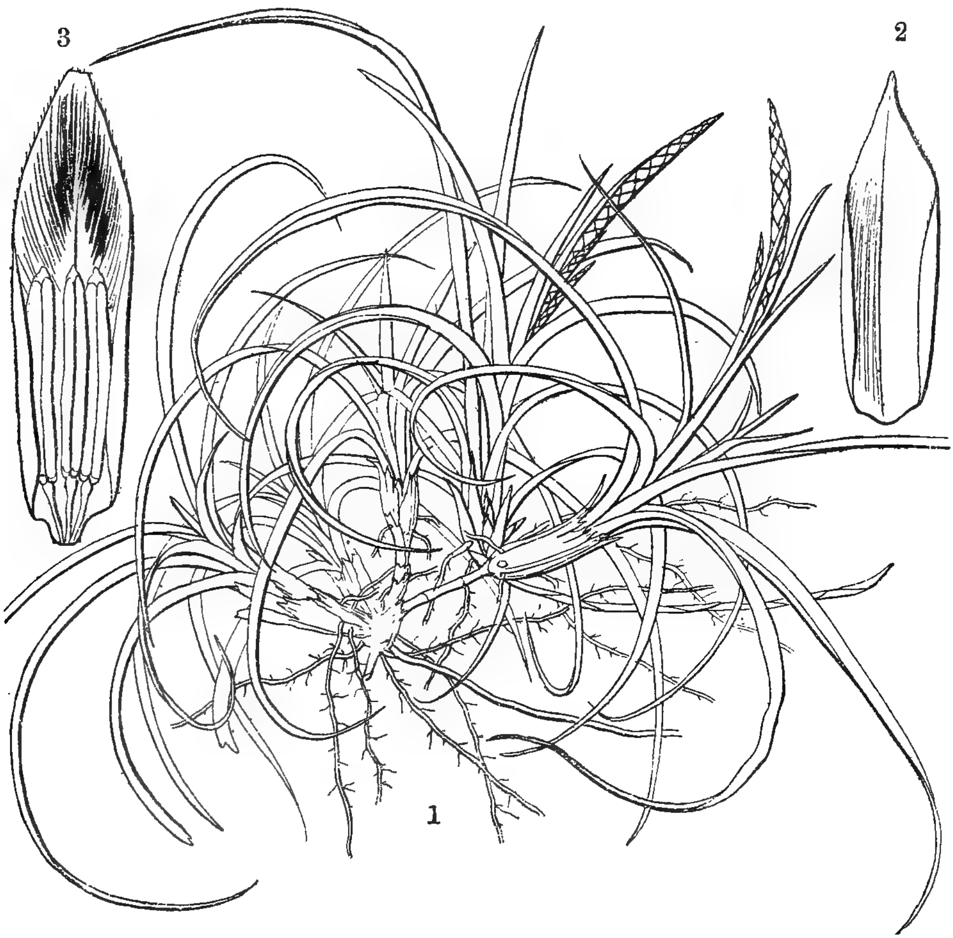

Fig. 42, *Carex gokwanensis* Hayata; 1, plant; 2, a scale of a female flower; 3, a scale of a male flower with stamens.

lævia; caulis spicifer 8 cm. longus foliifer; spica ♂ terminalis cylindrica 3 cm. longa 3 mm. lata solitaria; spicis ♀ tenuissimis lateralibus 2–3 cm. longis 2 mm. latis erectis. Fl. ♂: squamis valde imbricatis fusco-castaneis ovatis 5 mm. longis

3 mm. latis apice obtusis glabris; staminibus 3, antheris linearibus $2\frac{1}{2}$ mm. longis $\frac{1}{4}$ mm. latis apice breve appendiculatis. Fl. ♀: squamis imbricatis ovatis 4 mm longis 2 mm latis apice obtusis dorso medio trinerviis. Utriculus lineari-lanceolatus maturus ignotus latere scabridus.

HAB. Gokwanzan, leg. B. HAYATA, Aprili. 1916; Kwannon, leg. U. MORI, Aprili. 1910.

Near *Carex chrysolepis* FR. et SAV.

Carex longistipes HAYATA sp. nov. Folia linearia 40–50 cm. longa 3 mm. lata apice acuminata margine scabrida basi plus minus vaginiformia. Caulis spicifer 30–40 cm. longus foliifer sursum haud foliatus; spicis prope apicem 4–5 dispositis basi bracteatis, bracteis vaginiformibus 1 cm. longis 1 mm. latis apice oblique truncatis. Spica ♂: solitaria terminalis tenuissima 3–4 cm. longa $1\frac{1}{2}$ mm. latia longe pedunculata; spicis ♀: lateralibus 3–4 dispositis erectis 3 cm. longis 2 mm. latis, pedunculis 1–2 cm. longis. Fl. ♂: squamis imbricatis triangulari-ovatis $4\frac{1}{2}$ mm. longis $2\frac{1}{2}$ mm. latis apice obtusis. Fl. ♀: squamis triangulari-ovatis 3 mm. longis $1\frac{1}{2}$ mm. latis apice acutis glabris 1-nerviis. Utriculus linearis 5 mm. longus 1 mm. latus apice plus minus rostratus basi obtusus bilateralis latere costatus facie breve hirsutus, ore 2-dentato. Nucula oblonga $1\frac{1}{2}$ mm. longa $1\frac{1}{2}$ mm. lata apice plus minus constricta basi obtusa glabra lævis plus minus triquetra basi longe stipitata, stipite 2–$2\frac{1}{2}$ mm. longo glabro; stigmate 3-fido.

HAB. Akō, leg. Y. MATSUDA.

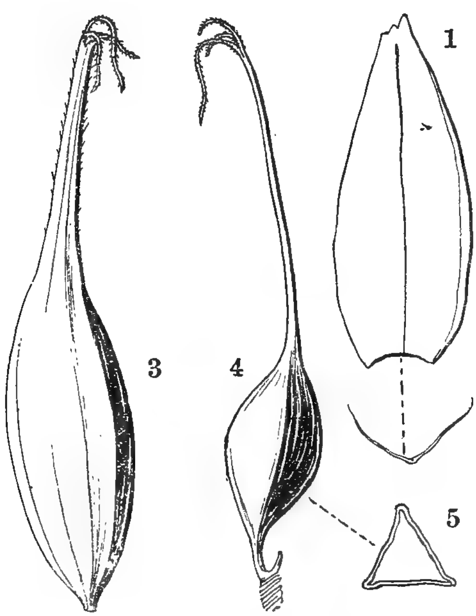

Fig. 43, *Carex alliiformis* CLARKE; 1, a scale; 2, section of the same; 3, an utricle; 4, a nutlet; 5, section of the same.

Near *Carex Shimadai* HAY.; but distinguishable from it in the long stalked nutlets; also near *Carex curvicollis* FR. et SAV., but differs from it in the much longer male and female spikelets.

Sect. ***Tumidæ.***

Carex alliiformis C. B. CLARKE (Fig. 43).; KÜKENTHAL Cyperaceæ-Caricoideæ, in das Pflanzenreich IV.–20, p. 618.

HAB. Tōyen, leg. U. FAURIE, Mart. 1914, No. 14.

Very remarkable for the presence of a rhacheola.

Sect. ***Rhomboidales.***

Carex chinensis RETZ.; HAYATA Gen. Ind. p. 90.

Carex atronucula HAYATA Gen. Ind. p. 89.

Carex hoozanensis HAYATA sp. nov. (Fig. 44). Fasciculus foliorum 5–6-aggregatus. Folia grandissima 95 cm. longa 17 mm. lata apice acuminata basi haud vaginata atroviridia facie glabra margine scabra. Caulis spicifer 20 cm. longus efoliatus $1\frac{1}{2}$ mm. in diametro sectionis haud foliatus haud squamatus apice 2–3-spiciger; spica ♂ terminalis erecta solitaria recta gracillima 4 cm. longa 1 mm. lata; spicæ ♀ laterales ad axillas bractearum dispositæ solitariæ erectæ subsessiles 2–3 cm. longæ 4–5 mm.

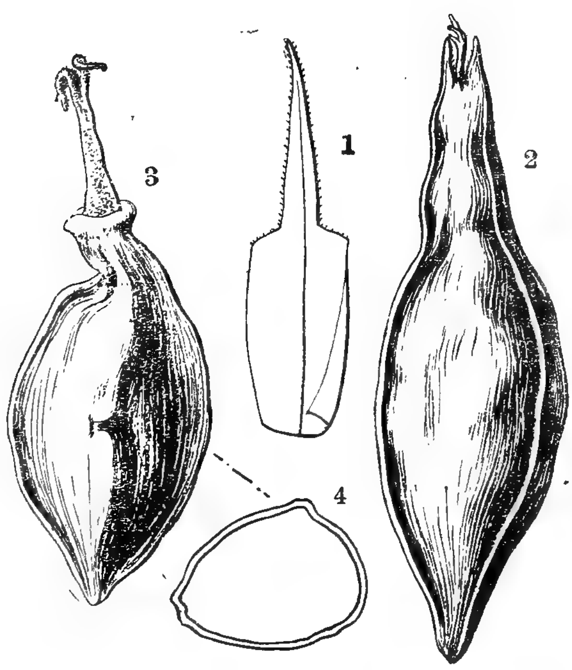

Fig. 44, *Carex hoozanensis* HAYATA; 1, a scale; 2, an utricle; 3, a nutlet; 4, section of the same.

latæ, bracteis linearibus 8 cm. longis 2–3 mm. latis acuminatis. Fl. ♂ dense imbricati, bracteis obovato-linearibus 4 mm. longis 1 mm. latis apice acuminatis crassiusculis, staminibus 3 erectis, antheris linearibus $1\frac{1}{2}$ mm. longis $\frac{1}{5}$ mm. latis apice truncatis, filamentis glabris brevibus apice clavatis. Fl. ♀: bracteis ovato-cuspidatis 4–5 mm. longis $1\frac{1}{2}$ mm. latis crassiusculis cuspidibus 2 mm. longis $\frac{1}{2}$ mm. latis margine hirsutis. Utriculus oblique ovoideo-fusiformis 6–7 mm. longus 2 mm. latus apice plus minus rostratus 2-dentatus glaber multinervius. Nucula obovoidea 4 mm. longa 2 mm. lata glabra apice rotundata oblique rostrata, rostro $\frac{1}{2}$ mm. longo valido, basi acuta triquetra, stylo basi conico-incrassato.

HAB. Hōōzan, ad 6000 ped. alt., leg. B. HAYATA, Aprili. 1916.

Near *Carex Harlandi* BOOTT.; but differs from it in the cup-shaped apex of the nutlets.

Carex remotiflora HAYATA sp. nov. (Fig. 45) Fasciculus foliorum basi vaginis atro-purpureis instructus, radicibus fibrosis. Folia linearia 30–50 cm. longa 3 mm. lata apice acuminatissima facie margineque glabra basi vaginiformia, vaginis 6–7 cm. longis $2\frac{1}{2}$ mm. in diametro, oribus truncatis, ligulis minutis glabris. Caulis 60 cm. longus gracilis 2–3-foliatus glaber; spica ♂ terminalis solitaria tenuissima 2–3 cm. longa 2 mm. lata; ♀ laterales gracillimæ longe pedunculatæ 5–6 cm. longæ 2–3 mm. latæ remote floriferæ. Fl. ♂: bracteis imbricatis lineari-obovatis 4 mm. longis $1\frac{1}{2}$ mm. latis medio viridibus cæterum hyalinis glabris, staminibus 3 erectis, antheris linearibus circ. 2 mm. longis $\frac{1}{5}$ mm. latis apice apiculatis. Fl. ♀: bracteis lineari-obovatis medio valde costatis. Utriculus longe ovoideo-fusiformis 7 mm. longus $1\frac{1}{3}$ mm. latus glaber triquetrus

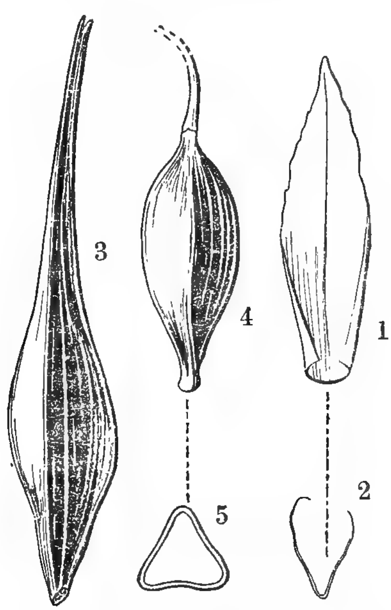

Fig. 45, *Carex remotiflora* HAYATA; 1, a scale; 2, section of the same; 3, an utricle; 4, a nutlet; 5, section of the same.

apice rostratus, ore 2-fido glabro. Nucula obovoideo-fusiformis 3 mm. longa 1 mm. lata glabra 3-quetra lævis.

HAB. Arisan, ad 2500 ped. alt., leg. U. FAURIE, Jun. 1914.

Near *Carex daisenensis* NAKAI, but differs from it in the quite glabrous utricles.

Carex sharyotensis HAYATA sp. nov. (Fig. 46). Folia linearia 40–50 cm. longa 3 mm. lata apice acuminata glabra. Caulis spicifer 30 cm. longus glaber plus minus foliatus, foliis caulinis minoribus, medio sursum spicifer; spica ♂ terminalis solitaria longe pedunculata cylindrica 3 cm. longa 3 mm. lata; spicis ♀ late-

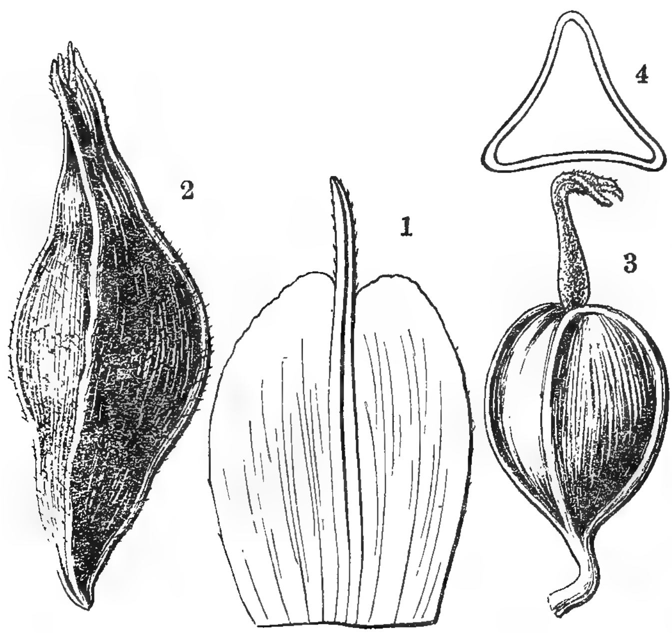

Fig. 46, *Carex sharyotensis* HAYATA; 1, a scale; 2, an utricle; 3, a nutlet; 4, section of the same.

ralibus axillaribus solitariis secus caulem 2–3–dispositis, rhachibus triquetris ad angulos hirsutis subsessilibus $1\frac{1}{2}$ cm. longis 5 mm. latis. Flores ♂: squamis imbricatis elongato-obovatis 5–6 cm. longis 2 mm. latis apice rotundatis apice medio seta $\frac{1}{2}$ mm. longa instructis. Fl. ♀: squamis oblongis 4 mm. longis $2\frac{1}{2}$ mm. latis apice emarginatis ad centrum cuspide 2 mm. longa instructis dorso valde 3–nerviis apice minute hirsutis. Utriculus parce hirsutus $6\frac{1}{2}$ mm. longus

$2\frac{1}{3}$ mm. latus apice breve rostratus 2-dentatus basi attenuatus sursum oblique recurvus. Nucula obovoidea apice rotundata basi acuta acute triquetra 3 mm. longa 2 mm. lata lævis basi stipitata, stipite flexuoso tortuoso.

HAB. Sharyōtō, leg. B. HAYATA, Mart. 1916.

Near *Carex tatsutakensis* HAY.; but differs from it in the flowering scales which are aristate at the obcordate apex.

Carex taihokuensis HAYATA sp. nov. Folia fasciculata 30–50 cm. longa 5–8 mm. lata apice acuminata margine scaberrima, costa scabra. Caulis spicifer 30 cm. longus basi 1–2-foliatus, foliis caulinis minoribus linearibus 4 cm. longis 2 mm. latis apice acuminatis, apice 2-bracteatus, bracteis linearibus 3 cm. longis $2\frac{1}{2}$ mm. latis acuminatis spicas valde superantibus. Spica ♂ terminalis solitaria erecta tenuissima 6–7 mm. longa 1 mm. lata pauciflorata; florum bracteis imbricatis oblongo-linearibus 5 mm. longis 2 mm. latis apice arista 2 mm. longa instructis, arista scabra. Spicæ ♀ laterales 1 cm.–2 cm. longæ prope apicem caulis dispositæ ad axillas bractearum solitariæ, pedicellis 2–3 mm. longis, florum bracteis ovato-oblongis $3\frac{1}{2}$ mm. longis $1\frac{1}{2}$ mm. latis apice arista $3\frac{1}{2}$ mm. longa scabra instructis. Utriculus rhomboideo-fusiformis 6 mm. longus 2 mm. latus apice rostratus basi acutus triquetrus parce hirsutus apice 2-dentatus. Nucula obovoidea $3\frac{1}{2}$ mm. longa 2 mm. lata lævis apice rotundata basi acuta triquetra.

HAB. Prope Taihoku, leg. U. FAURIE.

Near *Carex oligostachys* MEINS; but differs from it in the shorter utricles and oblong nutlets.

Diplocarex HAYATA n. g.

Diplocarex Matsudai HAYATA sp. nov. (Fig. 47). Folia linearia coriacea 60 cm. longa 6 mm. lata apice acuminata utraque facie et margine scabrida apice acuminata. Caulis spicifer haud foliatus 60 cm. longus triquetrus, spicis a medio caulis sursum remote dispositis basi bracteatis, bracteis vaginiformibus atro-fuscentibus 3–4 cm. longis 3 mm. latis apice plus minus laminiferis, laminis minoribus linearibus. Spica ♂: terminalis solitaria pedunculata cylindrica recurva 5–7 cm. longa 2 mm. lata; spicis lateralibus tenuibus cylindricis plus minus recurvis 6–7 cm. longis 4 mm. latis ad axillas bractearum solitariis. Fl. ♂:

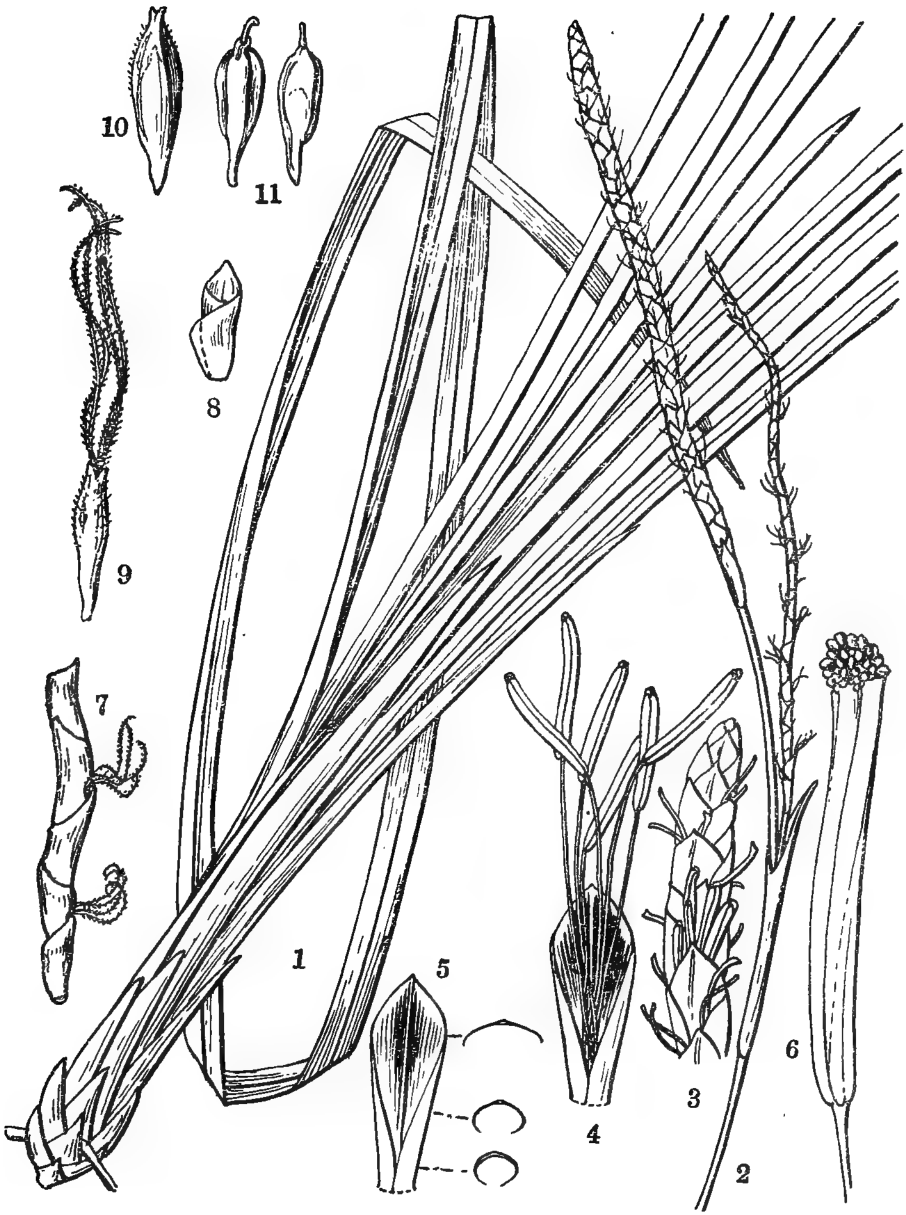

Fig. 47, *Diplocarex Matsudai* HAYATA; 1, the plant; 2, apical portion of an inflorescence; 3, a portion of a male spike; 4, a male flower; 5, a scale of the same; 6, a stamen; 7, a portion of a female spike; 8, a scale of a female flower; 9, a female flower; 10, an utricle; 11, ovary with a pair of lines on both dorsal and ventral sides.

valde imbricatis atro-fuscis basi vaginatis explicato triangulari-ovatis 6 mm. longis 5 mm. latis apice triangulari-obtusis 1-costatis, costis viridibus; stamina 6 vel 4, antheris linearibus 5 mm. longis $\frac{1}{5}$ mm. latis apice breve appendiculatis. Fl. ♀: squamis triangulari-ovatis $3\frac{1}{2}$ mm. longis $2\frac{1}{2}$ mm. latis apice cuspidato-acutis. Utriculus fusiformis hirsutus 6 mm. longus $1\frac{1}{2}$ mm. latus apice breve rostratus apice 2-dentatus basi longissime attenuatus multi-nervius plus minus tortuosus. Nucula obovoidea 3 mm. longa 1 mm. lata apice obtusa basi longe attenuata stipitiformis.

HAB. Akō: Paiwansha, leg. Y. MATSUDA; Rokkiri-Rōnō, leg. B. HAYATA.

Differs from *Carex* in the male flowers with 4–6 stamens, and in the 4–6 parted stigmata.

Lycopodiaceæ.

Lycopodium LINN.

Lycopodium remoganense HAYATA sp. nov. Caulis pendulus 40–50 cm. longus cum foliis 2 cm. latus glaber. Folia secus caulem a basi usque ad apicem spiraliter densissime disposita patentissima linearia $1-1\frac{1}{2}$ cm. longa 1 mm. lata margine integra glabra superiora sporangifera. Sporophylla linearia 12 mm. longa medio $\frac{2}{3}$ mm. lata basi $1\frac{1}{2}$ mm. lata. Sporangium reniforme 1 mm. longum $1\frac{1}{4}$ mm latum.

Lycopodium squarrosum HAYATA Gen. Ind. p. 117 (non FORST).

HAB. Remogan, leg. B. HAYATA, Mai. 1916, (typ.); Botansha; Bioritsu.

Near *Lycopodium squarrosum* FORST, but differs from it in the bracts which are nearly the same with the ordinary leaves.

Lycopodium Sieboldii MIQ. Prol. Fl. Jap. p. 348 et 390.

HAB. Inter Batakan et Uchitaroko, Aprili. leg. B. HAYATA et S. SASAKI.

Hymenophyllaceæ.

Hymenophyllum LINN.

Hymenophyllum retusilobum HAYATA sp. nov. Rhizoma repens gracillimum filiforme 1 mm. in diametro sectionis teres. Stipes 4–5 cm. longus

alatus. Frons oblongo-ovata 12 cm. longa 6 cm. lata apice acuminata bi-pinnatifida, partibus ultimis pinnularum linearibus 1–2 mm. latis 4–5 mm. longis apice obtusissimis et retusis utraque pagine glabris, costis utraque pagine elevatis. Sori terminales rotundati basi constricti 2-valvati, valvis late rotundatis 2–3 mm. in diametro, receptaculis stipitatis 1 mm. longis haud productis.

HAB. Uraisha, leg. Y. SHIMADA et T. ITŌ, Aprili. 1915.

Near *Hymenophyllum australe* WILLD.; but differs from it in having veins reaching just below the retused apex of the lobes.

Polypodiaceæ

Polypodium LINN.

Polypodium diversum ROSENST. in Hedwigia VI.–6, p. 346.
Polypodium Wrightii (HK.) var. *lobatum* ROSENST. l. c. p. 347.
Polypodium shintenense HAYATA Ic. Pl. Formos. VIII. p. 154.

Polypodium quasipinnatum HAYATA Gen. Ind. p. 112.
Polypodium Lehmanni HAYATA Gen. Ind. p. 112. (non METT.)

Polypodium quasidivaricatum HAYATA Gen. Ind. p. 112.
Polypodium palmatum HAYATA Gen. Ind. p. 112 (non BL.).

Cyclophorus DESV.

Cyclophorus Matsudai HAYATA sp. nov. (Fig. 48). Rhizoma repens squamatum, squamis lanceolatis 2–3 mm. longis $\frac{2}{3}$ mm. latis apice acuminatis rubrofuscentibus basi peltatis auriculatis. Stipes 5–8 cm. longus stellato-hirsutus 1-sulcatus. Frons hastato-lanceolata margine erosa 10 cm. longa 2 cm. lata lobo laterali basilari 1–2 cm. longo utraque latere basis instructa crasse coriacea supra tenuiter subtus dense floccosa stellato-hirsuta.

HAB. Ariko-banti: Thabogangœ, leg. Y. MATSUDA, Juli. 1919.

Near *Cyclophorus polydactylon*, but differs from it in having long hastate fronds.

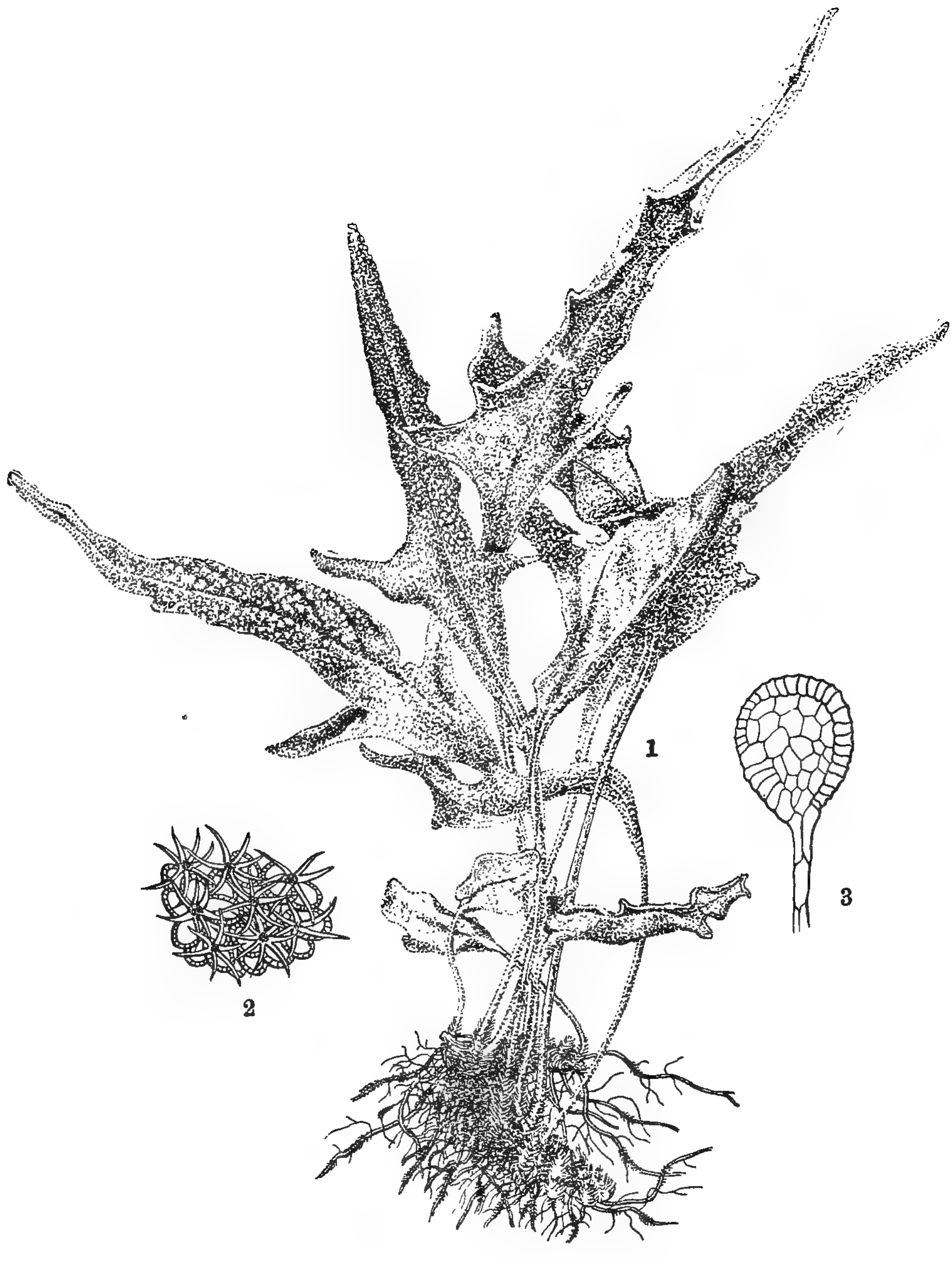

Fig. 48, *Cyclophorus Matsudai* HAYATA; 1, the plant; 2, a sorus; 3, a sporangium.

An Interpretation of GOETHE's *Blatt* in his "Metamorphose der Pflanzen", as an Explanation of the Principle of Natural Classification*

By

BUNZŌ HAYATA

Since my return from Tonkin (Indo-China), in August 1917, I have been reflecting on the principle of natural classification to which my attention was drawn during the score of years that I devoted to the study of the flora of Formosa. Current opinion demands that natural classification be based on the evolution theory, and consequently that the classification of plants should be in accordance with the phylogenetic tree. Much against my will, I have come to entertain strong doubts as to the correctness of this principle, so generally accepted by modern systematizers; for my twenty years' experience in systematic botany has steadily led me into quite a different channel of thought. This I now venture to make public, although I am aware that it will meet with a great deal of opposition. When studying the principles laid down by great authors such as DARWIN, HAECKEL, ENGLER, HALLIER and others,**

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* I must ask my readers' indulgence for the fact that this study was written before I had seen the most important literature bearing on the subject. I refer to HANSEN, ADOLPH :—Goethes Metamorphose der Pflanzen (Geschichte einer Botanischen Hypothese), 1907.

** Among the literature which treats of the principle of natural classification, I may mention the following works :—

DARWIN, C. — On the Origin of Species, (New York, 1890); Divergence of Character, and the Probable Effects of the Action of Natural Selection through Divergence of Character and Extinction, on the Descendants of a Common Ancestor, l. c. pp. 86-97; Classification, l. c. pp. 363-381.

HAECKEL, E. — Prinzipien der Generellen Morphologie der Organismen (Berlin, 1906); Das natürliche System als Stammbaum (Prinzipien der Klassifikation), l. c. p. 390.

ENGLER, A. — Erläuterungen zu der Übersicht über die Embryophyta Siphonogama, in den Natürlichen Pflanzenfamilien, Nachträgen zum II.-IV. Teil, (1897), pp. 358-380.

———, —. — Prinzipien der Systematischen Anordnung, im Syllabus der P flanzenfamilien siebente Auflage, Berlin, 1212.

HALLIER, H. — Provisional Scheme of the Natural (Phylogenetic) System of Flowering Plants, in the New Phytologist, Vol. IV., No. 7, July, 1905.

———, —. — Ein zweiter Entwurf des natürlichen (phylogenetischen) Systems der Blütenpflanzen, in den Berichte der Deutschen Bot. Gesellsch. XXIII., 2, pp. 85-91.

LOTSY, J. P. — Vorträge über Botanische Stammesgeschichte, I., Jena, (1907).

WETTSTEIN, R. — Handbuch der Systematischen Botanik (Zweite Auflage, 1911); Allgemeiner Teil, l. c. pp. 1-49.

my attention was occasionally, but very strongly, attracted by GOETHE's lines quoted in HAECKEL's Prinzipien der Generellen Morphologie der Organismen.* The quotation is as follows :—

> Eine innere und ursprüngliche Gemeinschaft liegt aller Organisation zugrunde; die Verschiedenheit der Gestalten dagegen entspringt aus den notwendigen Beziehungsverhältnissen zur Außenwelt, und man darf daher eine ursprüngliche, gleichzeitige Verschiedenheit und eine unaufhaltsam fortschreitende Umbildung mit Recht annehmen, um die ebenso konstanten als abweichenden Erscheinungen begreifen zu können.

It seemed to me that GOETHE's thought expressed in the above lines was, if I understood him correctly, the very idea which I had come to hold and which in my thought stood as the true principle of natural classification. When reading HAECKEL's work above mentioned, my interest was again aroused by another quotation from GOETHE. It reads** :—

> Sie (die Natur) schafft ewig neue Gestalten; was da ist, war noch nie, was war, kommt nicht wieder; alles ist neu und doch immer das Alte.
>
> Es ist ein ewiges Leben, Werden und Bewegen in ihr. Sie verwandelt sich ewig, und ist kein Moment Stillstehen in ihr. Für's Bleiben hat sie keinen Begriff, und ihren Fluch hat sie an's Stillstehen gehängt. Sie est fest; ihr Tritt ist gemessen, ihre Gesetze unwandelbar. Gedacht hat sie und sinnt beständig; aber nicht als ein Mensch, sondern als Natur. Jedem erscheint sie in einer eigenen Gestalt. Sie verbirgt sich in tausend Namen und Termen, und ist immer dieselbe.

Here again, in GOETHE's lines, I found the very idea which had already been forming in my mind and I was greatly struck with the singular agreement of GOETHE's thought and my own. This induced me to study GOETHE's idea more carefully and to follow it up in his "Metamorphose der Pflanzen***." There I found that his thought regarding the relation of vegetable organs was the same as that which I entertained in reference to the relation of species. His opinions changed a little at times, but that thought of his, which I considered to be correct, was the very idea which I believed to be the fundamental law of natural classification. Thus, in GOETHE I found my own idea

* HAECKEL, E.—Prinzipien der Generellen Morphologie der Organismen, (1906) p. 351.

Here GOETHE says that difference of forms arises from necessary adaptation to external conditions; but I would rather say that the difference of forms arises from the conditions according to the causal nexus.

GOETHE's "ein ursprüngliche, gleichzeitige Verschiedenheit" is, in my opinion, due to the difference of the genes possessed by the organisms.

** See Die Natur, in GOETHE's Sämtliche Werke, Band 45, pp. 41-43, (Leipzig).

*** GOETHE.—Die Metamorphose der Pflanzen, in Goethes Werke II.—6, pp. 25-94, (Weimar, 1891).

as to the principle of natural classification for which I could find no support in DARWIN, HAECKEL, ENGLER, HALLIER or others. In the following pages, it is my desire to explain GOETHE's "Metamorphose der Pflanzen," and to refer to the principle of natural classification found, as I believe, in his work. To understand his "Metamorphosenlehre" we must have a just and adequate idea of his *Blatt* which is as it were the hero of his work. The interpretation of this *Blatt* is the principal subject of this paper.

The "Metamorphose der Pflanzen," that celebrated work of the great poet, when looked at from the point of view of modern scientific knowledge, certainly contains many mistakes in minute details; but the principal idea in it, viz., that, although there are many kinds of vegetable organs, they are after all modifications of one and the same organ - *Blatt* which becomes, according to different circumstances, a foliage leaf, or a sepal, or something else, i.e. "die GOETHEsche Lehre von der Einheit aller Pflanzengestaltung" is generally considered to be on the whole a quasi-indisputable theory. Now, what is that one and the same organ - *Blatt* proposed by GOETHE?** To this question, many authors have given varying answers. GREEN* says in his History of Botany that "his (GŒTHE's) idea were not put before his readers very clearly, and left them sometimes uncertain whether he considered all leaves modifications of some ideal or theoretical form, or whether he held that a structure commencing its development in some particular direction might be actually diverted into another, and become something quite different from what it would have become, had its development not been interfered with." This is an interesting problem, the solution of which will on the one hand lead us to see directly the mutual relations of vegetable organs, and on the other will make us understand indirectly the relationship between the species themselves. It is, therefore, not only a question of morphology, but also an important problem of systematic botany.

As far as my investigation into GOETHE's studies extends, his methods are generally not inductive, but often deductive, as can be seen by the following quotation***.

* GREEN, J. R.—A History of Botany (1860-1900) 1909, p. 66.

** COHN, F.—Die Pflanzen (1896) p. 114.

*** BIELSCHOWSKY, A.—Goethe, sein Leben und seine Werke, II. p. 89.

Alles Erfinden, Entdecken die Ausübung eines originalen Wahrheitsgefühles sei, das im Stillen längst ausgebildet unversehens mit Blitzesschnelle zu einer fruchtbaren Erkenntnis führt. Es ist eine aus dem Innern am Äussern sich entwickelnde Offenbarung, die den Menschen seine Gottähnlichkeit vorahnen lässt. Es ist eine Synthese von Welt und Geist, welche von der ewigen Harmonie des Daseins die seligste Versicherung gibt.

As is generally accepted, GOETHE was greatly influenced by SPINOZA's doctrine "Einheit des Alles" which is advocated in many of his works; and so far as my studies extend, his "Metamorphose der Pflanzen" seems to be an explanation of that same philosophical idea illustrated by studies in morphology and the development of vegetable organs. I shall refer to this matter later on.

Before going into details, it is, therefore, necessary to pause a little to consider GOETHE's philosophical ideas*, and I trust I shall be pardoned if for that purpose I here reproduce some lines of his, quoted in the works of several authors.

Freudig war seit vielen Jahren
Eifrig so der Geist bestrebt,
Zu erforschen, zu erfahren,
Wie Natur im Schaffen lebt.
Und es ist das ewig Eine,
Das sich vielfach offenbart;
Klein das Große, groß das Kleine,
Alles nach der eigen Art,
Immer wechselnd, fest sich haltend
Nah und fern, und fern und nah
So gestaltend, umgestaltend—
Zum Erstaunen bin Ich da.

** Eine innere und ursprüngliche Gemeinschaft liegt aller Organisation zugrunde; ....

*** Die Natur schafft ewig neue Gestalten; was da ist, war noch nie, was war, kommt nicht wieder: alles ist neu und doch immer das Alte.

Es ist ein ewiges Leben, Werden und Bewegen in ihr. Sie verwandelt sich ewig, und ist kein Moment Stillstehen in ihr. Für's Bleiben.........

Jedem erscheint sie in einer eigenen Gestalt. Sie verbirgt sich in tausend Namen und Termen, und ist immer dieselbe·........

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* As to this point, my readers are requested to refer to BIELSCHOWSKY, A.:— Goethe, sein Leben und seine Werke, II. pp. 77-101 and pp. 412-439 (1911, München).

** *** These are more fully given in the quotations on p. 76 of the present paper.

Betrachten wir alle Gestalten, besonders die organischen, so finden wir, daß nirgend ein Bestehendes, nirgend ein Ruhendes, ein Abgeschlossenes vorkommt, sondern daß vielmehr Alles in einer steten Bewegung schwankt. Das Gebilde wird sogleich wieder umgebildet, und wir haben uns, wenn wir einigermaßen zum lebendigen Anschauen der Natur gelangen wollen, selbst so beweglich und bildsam zu erhalten, nach dem Beispiele, mit dem sie uns vorgeht.

To interpret his thoughts from the foregoing quotations, his main idea seems to be that organic beings and their organs perfectly agree in their basic characters, but that they manifest different shapes through the varying conditions present in the causal nexus. As manifestations change from time to time, many new forms are produced; yet, in their real being, they are always one and the same. His idea consequently is that of the basic unity of existence.

He regarded a species or an organ not as an individuum, but as a collection of many things with different generating qualities or genes (to borrow an expression used in genetics). In this connexion readers are requested to consult the following lines*.

Jedes Lebendige ist kein Einzelnes, sondern eine Mehrheit; selbst in sofern es uns als Individuum erscheint, bleibt es doch Eine Versammlung von lebendigen selbstständigen Wesen, die der Idee, der Anlage nach gleich sind, in der Erscheinung aber gleich oder ähnlich, ungleich oder unähnlich werden können. Diese Wesen sind teils ursprünglich schon verbunden, teils finden und vereinigen sie sich. Sie entzweien sich und suchen sich wieder, und bewirken so eine unendliche Produktion auf alle Weise und nach allen Seiten.

Je unvollkommener das Geschöpf ist, destomehr sind diese Teile einander gleich oder ähnlich, und destomehr gleichen sie dem Ganzen. Je vollkommener das Geschöpf wird, desto unähnlicher werden die Teile einander. In jenem Falle ist das Ganze den Teilen mehr oder weniger gleich, in diesem das Ganze den Teilen unähnlich. Je ähnlicher die Teile einander sind, desto weniger sind sie einander subordinirt. Die Subordination der Teile deutet auf ein vollkommneres Geschöpf.

Daß nun das, was der Idee nach gleich ist, in der Erhfahrung entweder als gleich oder als ähnlich, ja sogar als völlig ungleich und unähnlich erscheinen kann, darin besteht eigentlich das bewegliche Leben der Natur, das wir in unsern Blättern zu entwerfen gedenken.

Bielschowsky interprets "lebendige selbstständige Wesen" in the above lines as cells constituting organic beings. He is right, but I think that the word "Wesen" may equally well be translated "gene" in the meaning in which the word is used by students of genetics. "Unvollkommenere Geschöpfe" in the same quotation can be regarded as beings which have more latent genes and fewer apparent genes; and the "vollkommenere" may be taken as beings

* Goethes Werke II.—6, pp. 10-12 (Weimar, 1891).

which have comparatively fewer latent genes and more apparent genes. " Unvollkommenere " and " vollkommenere " are both in co-ordination, the former cannot be considered to be inferior to the latter. The same idea is expressed also in the following quotation, though, as is explained by COHN, it actually means that even a single plant is in reality not an individuum, but is truly a collective being consisting of a stem, roots, leaves and many other parts.

Freuet Euch des wahren Scheins,
Euch des ernsten Spieles,
Kein Lebendiges ist Eins,
Immer ist's ein Vieles."

GOETHE'S idea also to some extent approaches the doctrine of TENDAI* which in viewing sentient beings does not look at them as characters of on,) quality, but beholds them as a collection of different qualities (or factorse which are sometimes latent and at other times apparent, according to the circumstances conditioning the inevitable causal nexus

GOETHE expressed another idea in the following lines.

> Soviel aber können wir sagen, daß die aus einer kaum zu sondernden Verwandtschaft als Pflanzen und Tiere nach und nach hervortretenden Geschöpfe nach zwei entgegengesetzten Seiten sich vervollkommnen, so daß die Pflanze sich zuletzt im Baum dauernd und starr, das Tier im Menschen zur höchsten Beweglichkeit und Freiheit sich verherrlicht.

In the above quotation, " eine kaum zu sondernde Verwandtschaft " should be interpreted as the Flagellata** which is, at present, supposed to be the starting point of plants and animals in their phylogeny.

Here we see that some of his ideas imply that many species or organs originate from one source and thence it results that the relations between species or organs are explainable by the evolution theory. But his more mature thought, as we have seen before and shall see later on, does not admit of a single origin for all organs or organic beings, but approaches a view which finds origin in every thing. According to the latter view, there were originally numerous things undergoing endless changes either in themselves or by combining with or separating from others, thus producing numerous new forms; they are new, it is true, but they are new only in form

* Readers are requested to refer to TENDAI'S Doctrines of the Middle Path and Reality, interpreted in English by Prof. MASAHARU ANEZAKI.

** WETTSTEIN, R. R. — Handbuch der Systematischen Botanik (1911) p. 54.

or in combination; such a thing as a new element or gene can never be produced. Their phenomenal appearances are, therefore, altered; but their real entities are unchangeable, and always remain the same as before. Consistently with this idea, the mutual relation between species or organs becomes explainable by the participation theory, which I shall explain later on. GOETHE'S opinion, therefore, sometimes inclines to the evolution theory, and sometimes to the participation theory; but it is indisputable that his idea that a leaf and a petal are but modifications of one and the same organ comes from his cherished "Einheit des Allės," and I think that his "Metamorphose der Pflanzen" is, as I have stated above, an explanation of this idea as illustrated by the phenomena of the vegetable world. This view of mine is quite different from the interpretations of various authors who regard the vegetable organs (leaf, sepal, stamen or pistil) as modifications of some ideal or theoretical form, or of a foliage leaf. GOETHE'S thought is, so far as I can judge, that the leaf and the petal are one and the same thing in real entity but different in shape. He said, therefore, that a leaf is changeable into a petal and a petal into a leaf, and even in the case where we see a leaf changing into a petal, we do not see any thing new which was not there before. Every thing expressed in a leaf is here manifested in a petal, but in a different shape. This idea of GOETHE'S has often been interpreted by later scholars as an idea of the evolutionary theory.* But I can not agree with this position. His thought is, at any rate, a "Einheitslehre" and is that which should be explainable by a theory which I shall expound immediately further on.

In order to interpret GOETHE'S idea in his "Metamorphose der Pflanzen", I now desire to propose a theory which I will call the participation theory**. It is in fact but one theory, yet for convenience' sake I shall treat it as two, namely:—the theory of the mutual participation of the gene, and the theory of the mutual sharing of the gene***. Literally speaking, the word "participation" seems to express a united action of genes to produce a certain result.

* COHN, F. — Die Pflanzen (1896) p. 122.

** In formulating this theory, I have been influenced by a suggestion from TENDAI'S theory of mutual participation.

*** As to what is the gene, readers are requested to refer to two similes given on pp. 83–84 of the present paper.

Different genes participate in the effort to produce the resulting plant or plant organ. Different plants or plant organs on the other hand are found to share in the work of certain genes, or combination of genes; or perhaps we may say that the word "participation" points to the future, while the word "sharing" points to the work accomplished in the past. Thus, different genes participate in the work of producing a certain result, while different plants share with one another the work of certain genes. It must be admitted, however, that my theory does not necessarily agree with that used in genetics*, but is rather to be regarded as the latter theory broadened to the utmost limit.

Now, in order to help my readers to understand my theory, it is necessary to insist on the law of substance, i. e. the conservation of energy and the indestructibility of matter; that the universe in its real entity is ever the same — the same now as in the past and as in the future; that it is only the phenomena which change from time to time; and that there can be neither increase nor decrease in its real entity.

All individuals in the universe have close relations with the whole (i. e. the universe), and their real entities are something like the threads of a net extending in all directions through the universe; some of the threads being represented by chemical affinities or physical gravity. To divide the whole into parts is something like moving the interwoven threads hither and thither with one's fingers; for, though the whole is divisible into parts as it seems, these parts are still connected one with another by the threads. Individuals though they be called, they are not by any means in a condition of isolation, but rather are closely related to the whole. Thus, as a part moves, so moves the whole itself — that assemblage of many parts.

All individuals alike possess innumerable genes or factors**. The former present various phenomena according as, on the one hand, the latter are

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* Morgan, T. H. — The theory of the gene, in Am. Nat. (1917) vol. 51, pp. 513-520.

** My idea is somewhat comparable to Vines' opinion that "the ultimate members, root, stem, leaf, may in this view be looked upon as potentially present even in the unicellular plant, just as man is potentially in the Amoeba; and their gradual unfolding is but a matter of time and the realisation of their inherent tendency to complexity, much as we have in the spore or the ovum the potentialities which we see realised as it grows into a plant."........ [Green, J. R. — A History of Botany, (Oxford 1909) p. 83].

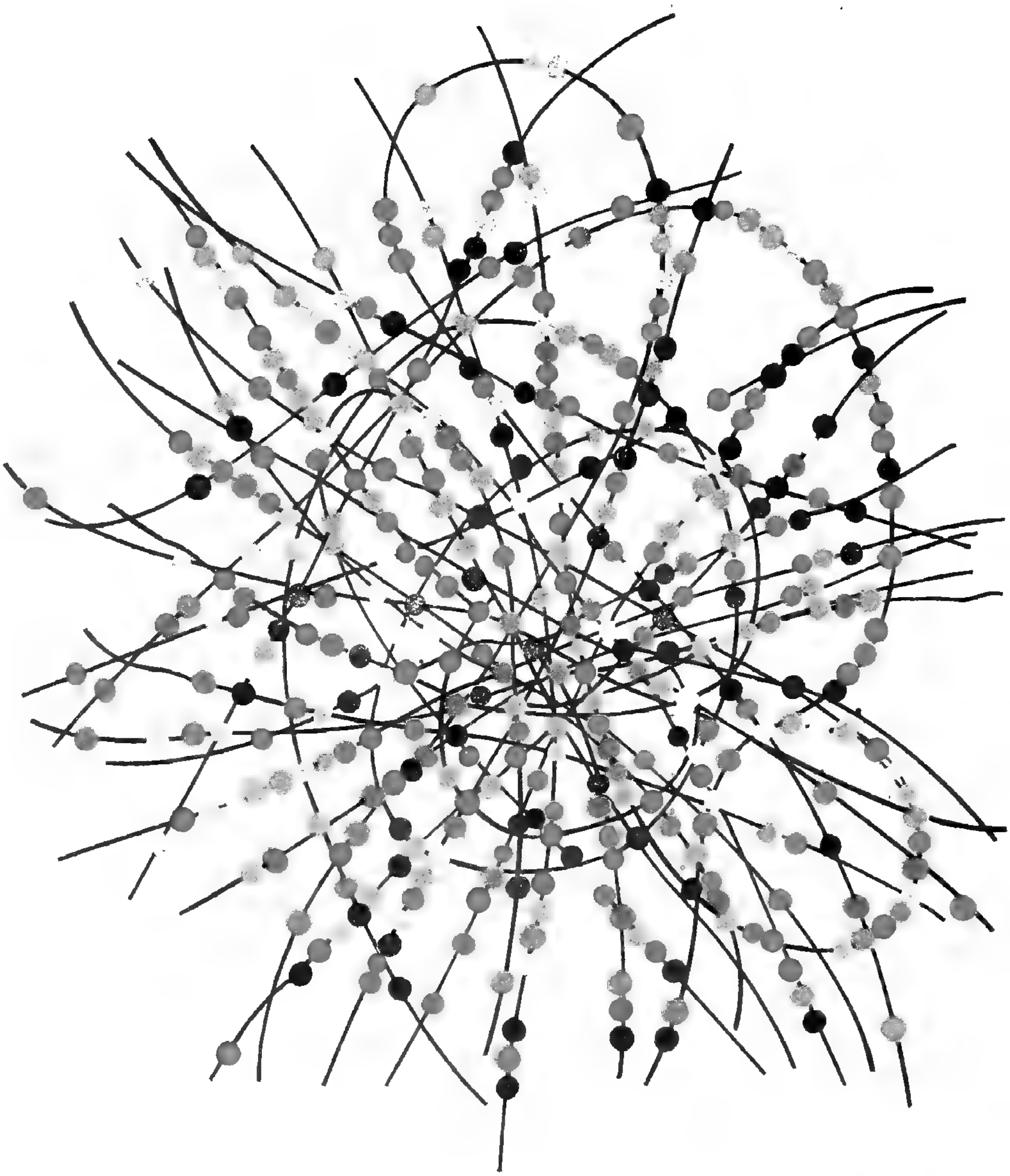

Fig. 1. A sketch showing an arrangement of genes contained in individuals; the rosary-beads representing genes, which change from time to time as if they were in one current of communication in their essence. Although in the above case, as I was trying to explain my idea in the simplest way, I regarded the rosary as a line in one plane, yet we may assume that the same rosary may be extended in boundless space of three dimensions; at the same time, our rosay-beads may be regarded as solid bodies of three dimensions.

apparent or latent; and on the other, according to the different combinations or seggregations of apparent genes. Consequently, the relation of one individual to the others in phenomenal appearance is the relation of mutual participation or sharing of latent and apparent genes in individuals.

Then, too, all genes in individuals may be apparent at one time and latent at another, and may change their characters, according to conditions. As genes change, so change individuals. Yet, no new gene is ever created or produced; no existent gene ever vanishes. The genes now present are those that have existed from the eternal past and will continue to exist throughout the infinite future. The phenomena of an individual change from time to time, the latter phrase of course being understood as meaning very long intervals of time. Such changes are brought about in the individual itself or by crossing with others. When the latter is the case, it sometimes does, and sometimes does not, follow the Mendelian law. Yet, for all that, individuals are always the same in their real entities. Genes present in individuals are not at all isolated, but are in close continuity in their essence. If we fix upon different colours to represent different genes, the latter present different hues, according to the conditions under which they are exposed at this time or that. Different genes are, therefore, exactly similar in their real entities. Consequently, all individuals are to be regarded from two different points of view; one being that of universality, and the other that of particularity. The universality of individuals follows from the unity of the genes contained in them, while the particularity of individuals is made comprehensible by the difference of the phenomenal appearances of the genes and the different combinations of the latter.

Now, in order to present to my readers more plainly the mutual relation of genes present in individuals, let us assume that individuals are composed of numerous rosaries formed of numerous, temporarily different, beads. (See Fig. 1). Further, we will assume at the same time that the individuals are, as I have said before, something like knots caused by bringing close together here and there some of these entangled rosaries; also that the phenomenal appearances of the beads of the rosaries do not cease to change from time to time, as the beads are in close concatenation and in incessant flux in their essence; as the

beads change, so do the phenomenal appearances of individuals (if we think of unlimited time). These beads somewhat correspond to the genes of which I have spoken before; and they in the limited sense of phenomenal appearances correspond, at the same time, to what are called genes by the student of genetics. It must be granted, however, that though I have compared the beads to the genes, yet the former denote only fixed qualities of something generated, while the latter indicate generating qualities united with something generated. I may here add another simile* as an explanation of my conception of individuals and genes. The universe is like a boundless net with innumerable millions of crystalline beads, each on a mesh of a different colour, each reflecting the images of other beads, and each consequently presenting different hues, according to the position of the observer. The beads present different hues, according as they are observed from this point or that. It is, however, only in their phenomena that they are different; in their real entities, they are all and ever the same crystalline beads. Each bead with innumerable millions of reflected images (say dots) of all varieties of colours (of which it must be understood some are visible, but some are invisible, according to the position of the observer) is something like an individual, and the images on each bead (the dots of different colours) correspond, so to speak, to the genes of which I have spoken above.

The most important point in my theory is that, however much we may have spoken both of real entity and of the phenomenal appearance, of individuals and genes, independently one from the other, yet the two should only be thinkable in their identity in oneness, and be inconceivable independently of one another.

As can be seen from the explanation given above, the first theory that an individual is not to be considered as a character of a single quality, but as in reality a compound of different things generated by different genes, is called the theory of the mutual participation of the gene; the other theory that the relation of individuals to others in their particularity is the relation

* In presenting this metaphor to my reader, I have been influenced by a suggestion from the Indra-nets, an allegory found in one of the Buddhist scriptures, which is called the Mahavaipulyabuddhaganda vyūha-sūtra (Kegonkyō). For this allegory, I am indebted to Professor J. Matsumura; I have not myself consulted the original scripture.

of the mutual sharing of genes in phenomenal appearance in individuals is called the theory of the mutual sharing of the gene.

Should these theories be accepted, GOETHE's idea in his "Metamorphose der Pflanzen" would find a better interpretation than in the case at present. According to these views, all vegetable organs are one and the same in their real entity. That there are so many different organs, such as leaf, sepal, petal, stamen and others is due to the fact that the genes contained in the organs present suitable temporary phenomenal appearances, in agreement with the conditions of the past, present and future, that is to say the conditions which follow necessarily through the causal nexus. It is not, however, intended that this assertion should be understood in the sense that all organs are the same at the commencement of their development, and merely present different shapes after full growth, according to the different conditions which come later on. But it should be understood that foliage leaves and sepals are different even in their very beginning, though they then look very much the same. The very beginning of a leaf was, is and will be, so conditioned as to be a foliage leaf after its development; as the very beginning of a sepal is to be a sepal after attaining its full growth. In this sense, the beginning of a foliage leaf is different from that of a sepal. Yet, different as they are, they are different only in conditions; they are all the same in their real entity. As the conditions are different, so the combinations of the apparent genes and the proportions of apparent and latent genes differ; so in consequence their phenomenal appearances will differ. The same is true as to adult as well as to nascent organs. Thus much having been said, let us consider GOETHE's original work section by section.

§ 1. Ein jeder, der das Wachsthum der Pflanzen nur einigermaßen beobachtet, wird leicht bemerken, daß gewisse äußere Theile derselben sich manchmal verwandeln und in die Gestalt der nächstliegenden Theile bald ganz, bald mehr oder weniger übergehen.

§ 3. ....wir lernen die Gesetze der Umwandlung kennen, nach welchen sie (Natur) einen Theil durch den andern hervorbringt, und die verschiedensten gestalten durch Modification eines einzigen Organs darstellt.

In the above quotations § 3, we come upon the expression "einziges Organ" which is certainly what is called GOETHE's *Blatt* by his readers. The most suitable way to interpret his *Blatt* is to regard it as a real entity which

can be conditioned in any way whatever by causation. As this entity is found in any organ, or to speak more correctly, as it is the organ itself, GŒTHE's "einziges Organ" is never a theoretical or hypothetical form, but one really existing. It is a real entity which exists in the form of an organ, be it a petal, a sepal or a foliage leaf.

> § 4. Die geheime Verwandtschaft der verschiedenen äußern Pflanzentheile, als der Blätter, des Kelchs, der Krone, der Staubfäden, welche sich nach einander und gleichsam aus einander entwickeln, ist von den Forschern im Allgemeinen längst erkannt, ja auch besonders bearbeitet worden, und man hat die Wirkung, wodurch *ein und dasselbe Organ* sich uns mannichfaltig verändert sehen läßt, die Metamorphose der Pflanzen genannt."

Here again, in the words italicized above, *ein und dasselbe Organ* means at any rate a real entity which can be conditioned in any way whatever by the law of causation. All organs are the *ein und dasselbe Organ* which can produce any organ. The origin is, therefore, not limited to a single individual; all organs are origins from which any other organ may be produced.

GOETHE planted a seed, studied the cotyledons, and came to the conclusion that the latter are not particular organs, but should rather be regarded as the first leaves on the stem. In the following quotation, he states the unity of foliage leaves and cotyledons*.

> § 14. Endlich erscheinen sie (Kotyledonen) uns als wirkliche Blätter, ihre Gefäße sind der feinsten Ausbildung fähig, ihre Ähnlichkeit mit den folgenden Blättern erlaubt uns nicht sie für besondere Organe zu halten, wir erkennen sie vielmehr für die ersten Blätter des Stengels.

In § 22, he refers to the unity of a petiole and leaf-blade**. Then in § 28, he comes to flowers.

> § 28. Wir sehen endlich die Blätter in ihrer größten Ausbreitung und Ausbildung, und werden bald darauf eine neue Erscheinung gewahr, welche uns unterrichtet: die bisher beobachtete Epoche sei vorbei, es nahe sich eine zweite, die Epoche der Blüthe.

If we consider the meaning of the above lines, as it is literally expressed, it seems to imply that foliage leaves change themselves into flower-leaves (i. e.

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* As to the relation between cotyledons and leaves, my readers are requested to refer to GOEBEL's 'Organographie der Pflanzen' (1898-1901) pp. 588-605. In my opinion, cotyledons and leaves are similar in their basic characters, but present different manifestations, in agreement with the conditions which follow necessarily through the causal nexus.

** Cf. GOEBEL, K. – Organographie der Pflanzen (1898-1901) pp. 581.

sepals or petals and so on). But, this can by no means be laid down as a general proposition; it can only be maintained in cases where we have evidence to that effect. GOETHE's lines should, therefore, be explained in the sense that when an entity, which could be a foliage leaf if conditioned to that effect, is conditioned to become a floral leaf, it appears as the latter. This implies undoubtedly the basic identity of the foliage and the floral leaf.

In § 32, he proceeds as follows:—

> § 32. Daß die Blätter des Kelches eben dieselbigen Organe seien, welche sich bisher als Stengelblätter ausgebildet sehen lassen, nun aber oft in sehr veränderter Gestalt um einen gemeinschaftlichen Mittelpunct versammlet stehen, lässt sich, wie uns dünkt, auf das deutlichste nachweisen.

The above quotation is very interesting. The first half asserts on the one hand that a sepal and a leaf are one and the same thing and thereby points out the idea of the universal foundation of all vegetable organs. But the second half, on the other hand, recognizes the difference between a sepal and a leaf and expresses the idea of the particular manifestations of the organs; and the whole sentence unites the two ideas, i. e. universal foundation and particular manifestation into perfect oneness. In this case, and in all the other cases as well, we must not think of foundation and manifestation as separate and one after another, but must consider them as united and simultaneous in oneness. Here we see, in the above case, the unity of universal foundation and particular manifestation. "Dieselbige Organe" in the above lines mean that the very same real entity, which becomes a "Kelchblatt" when conditioned to be such, becomes a "Stengelblatt" when conditioned to appear as such. We can not decide whether it is either 'Stengelblatt' or "Kelchblatt," unless it is definitely ascertained to be one or the other. The above quotation is, therefore, not to be understood so as to mean that a sepal is changed from a foliage leaf; but, it explains the unity of the foliage leaf and the sepal.

In § 33, GOETHE compares the verticillate arrangement of sepals and cotyledons (of the Coniferæ) and discusses the unity of the two. Viewed from the stand-point of modern systematic botany and morphology, the resemblance of the two (cotyledons and sepals) is not regarded as a token of a real

relationship, but as a mere accidental feature, and accordingly GOETHE'S treatment looks as if he compared two things which by nature are totally different and incapable of comparison. But, herein I do not concur in the general opinion. The resemblance occurs wherever the same apparent genes occur. In the case of such comparison, there can be no difference between real and accidental resemblance*. Verticillate arrangement may occur everywhere, be it in sepals or in cotyledons, where the genes causing the same arrangement occur. The present example explains that there exist the same genes together with many different ones in sepals and cotyledons. In section 33, he makes the following statement:—

> § 33. Wir haben schon oben bei den Cotyledonen eine ähnliche Wirkung der Natur bemerkt, und mehrere Blätter, ja offenbar mehrere Knoten, um einen Punct versammlet und neben einander gerückt gesehen. Es zeigen die Fichtenarten, indem sie sich aus dem Samenkorn entwickeln, einen Strahlenkranz von unverkennbaren Nadeln, welche, gegen die Gewohnheit anderer Cotyledonen, schon sehr ausgebildet sind; und wir sehen in der ersten Kindheit dieser Pflanze schon diejenige Kraft der Natur gleichsam angedeutet, wodurch in ihrem höheren Alter der Blüthen= und Fruchtstand gewirkt werden soll.

In the above lines, "diejenige Kraft der Natur" should be interpreted as representing a gene causing verticillate arrangement.

Further, he goes on to compare foliage leaves and the gamophyllous calyx; but here he does not mean that the leaves unite (themselves) to produce the gamophyllous calyx; but rather that there exists the same "Kraft der Natur" in both the verticillate leaves and the uniting sepals, and accordingly the same arrangement results. Any real entity, when conditioned to show the same genes, presents the same form. In the present case, calyx-leaves and foliage-leaves, since they are conditioned to present the same gene causing verticillate arrangement, are arranged around the axis. They are all the same in their real entity, but their conditioned states in the past, present and future are different. Section 36 runs as follows:—

> § 36. Diese Kraft der Natur, welche mehrere Blätter um eine Axe versammlet, sehen wir eine noch innigere Verbindung bewirken und sogar diese zusammengebrachten modificirten Blätter noch unkenntlicher machen, indem sie (Kraft) solche unter einander manchmal ganz, oft aber nur zum Theil verbindet, und an ihren Seiten zusammengewachsen hervorbringt.....

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* Cf. LOTSY, P. J.—Evolution by Means of Hybridization, (1916) pp. 137–138.

Here "diese Kraft der Natur" should have the same meaning as I have indicated above. Also in § 38, GOETHE treats of the unity of a sepal and other organs. The section runs as follows:—

> § 38. Die Natur bildet also im Kelch kein neues Organ, sondern sie verbindet und modificirt nur die uns schon bekannt gewordenen Organe, und bereitet sich dadurch eine Stufe näher zum Ziel.

It explains that the calyx is not at all a new thing; it is only a modification of what we had already been considering. In other words, it is a different combination of the genes which we had seen before. It means, in the end, that the things which exist existed originally; there is no such thing as the creation of an absolutely new thing.

In §§ 41, 42, 43 and 44, he says that a petal is also the same as a foliage leaf and that there are transitional forms between the one and the other. He states also that a foliage leaf passes over into a petal, without passing through the calyx stage. According to my opinion, this does not mean that a leaf changes into a petal, but it explains that there exists a transition between the petal and the leaf, just as there is unity in the two. In §§ 46 and 47, he goes on to discuss the unity of a petal and a stamen and speaks of the transitional forms between the two. In § 47, he says:—

> § 47. Die Natur zeigt uns in einigen Fällen diesen Übergang (der Kronenblätter und Staubblätter) regelmässig, z. B. bei der Canna, und mehreren Pflanzen dieser Familie. Ein wahres, wenig verändertes Kronenblatt zieht sich am obern Rande zusammen, und es zeigt sich ein Staubbeutel, bei welchem das übrige Blatt die Stelle des Staubfadens vertritt.

As to the stamens of the *Canna*, it is stated, according to the current opinion*, that the greater number of the organs which are to be originally stamens turns into petaloidal ones (staminodes) of an ornamental character, but only one of them retains imperfectly (one half) its original shape. In this, I do not concur. According to my idea, it should not be said in this case that organs which are originally destined to be stamens turn into petaloidal organs (i.e. staminodes); but it would be correct to regard the real entities (of the organs), which are to turn into any form whatever according to the causal

* EICHLER, A. W. — Blüthendiagramme (Leipzig, 1875) p. 174.
SCHUMANN, K. — Praktikum für morphologische und systematische Botanik. (1904) pp. 545–546.

nexus, as here in this case, in greater proportions, conditioned to present the genes causing petaloidal forms or staminodes, but in far lesser proportions, conditioned to present the genes causing the production of a stamen. Whenever we have secured actual evidence in the matter, concerning stamens turning into petaloidal organs, or petals changing to stamens, then we can arrive at some definite conclusion. But this will be the case only in the instance actually observed. It is not proper to extend the same conclusion to cases where we have no actual evidence, since it is a conclusion which we reached through limited experience.

The stamen proper to the *Canna* (but not the ordinary one) is, so to speak, conditioned partly to be an ordinary stamen, and partly to be a petal. It represents a transitional form between a petal and a stamen, and therefore participates in the genes of an ordinary petal and of a stamen. The relation of the petal, stamen and staminode is, therefore, actually represented by the mutual sharing of the genes of the phenomenal appearance possessed by the three floral elements. The genes in the phenomenal appearance are partly different and partly similar in the different organs. But the genes in the real entity are all the same in every organ. Therefore, one who sees the universal foundation (basic unity) of organs is looking at the genes in their real entity; and one who sees the particular manifestations of organs is considering the mutual sharing of the genes in their phenomenal appearance in different organs.

Goethe in § 51, compares nectaries, foliage leaves, sepals and petals. He takes the 'Nebenkrone' of the *Narcissus* as an instance in point; in this, I think he is right. Although in § 57 he explains an instance where nectaries turn into petals, he only intends to explain by this instance the unity of nectaries and petals; but not to decide that petals are necessarily metamorphosed nectaries, or nectaries are exclusively transformed petals.

Thus, he compares all vegetable organs such as the leaf, sepal, petal stamen, pistil, fruit and seed, and tries to explain the unity in their fundamental characters. Some errors may have crept into the examples given by him, but the correct idea underlying his thought is justly to be interpreted as the doctrine of the unity of all organs. In § 115, he says :—

§ 115. Es mag nun die Pflanze sprossen, blühen oder Frühte bringen, so sind es doch nur immer dieselbigen Organe welche, in vielfältigen Bestimmungen und unter oft veränderten Gestalten, die Vorschrift der Natur erfüllen. *Dasselbe Organ*, welches am Stengel als Blatt sich ausgedehnt und eine höchst mannichfaltige Gestalt angenommen hat, zieht sich nun im Kelche zusammen, dehnt sich im Blumenblatte wieder aus, zieht sich in den Geschlechtswerkzeugen zusammen, um sich als Frucht zum letztenmal auszudehnen.

His *dasselbe Organ* italicized in the above quotation means the same real entity, which turns into a leaf if it is on the stem, into a sepal on the calyx, into a petal on the corolla, and into a stamen or pistil in case of sporophylls. This is never intended to mean that leaves turn into sepals, sepals into petals, petals into stamens, or vice versa. It is *dasselbe Organ* which is the same in its real entity and which may turn into a stamen or leaf, according to the causal nexus. As I have said before, GOETHE's *dasselbe Organ* is neither an hypothetical nor a theoretical form, but should be regarded as a real existence. The forms of organs or their phenomenal appearances may change from one to others, or may not change. Whether they alter or not, there can be neither loss nor gain in their real existence.

In § 119*, GOETHE expresses himself as follows :—

§ 119. So wie wir nun die verschieden scheinenden Organe der sprossenden und blühenden Pflanze alle aus einem einzigen nämlich dem Blatte, welches sich gewöhnlich an jedem Knoten entwickelt, zu erklären gesucht haben: so haben wir auch diejenigen Früchte, welch ihre Samen fest in sich zu verschließen pflegen, aus der Blattgestalt herzuleiten gewagt.

He says, in the above quotation, that all vegetative and reproductive organs can be elucidated by one organ, namely a foliage leaf on a stem. His meaning is, however, to be so interpreted as that all organs are explainable by one single organ (for which any organ will do, yet, to mention the by far most common example), the foliage leaf. If he had meant "eine einzige" as limited to a foliage leaf, I should say, he would have been mistaken. The correctness of my interpretation will be seen by considering the following lines**.

§ 120. ....Denn wir können eben so gut sagen: ein Staubwerkzeug sei ein zusammengezogenes Blumenblatt, als wir von dem Blumenblatte sagen können: es sei

* Goethes Werke II.—6, p. 92 (Weimar).

** Goethes Werke II.—6, p. 93 (Weimar).

ein Staubgefäß im Zustande der Ausdehnung; ein Kelchblatt sei ein zusammengezogenes, einem gewissen Grad der Verfeinerung sich näherendes Stengelblatt, als wir von einem Stengelblatt sagen können: es sei ein, durch Zudringen roherer Säfte, ausgedehntes Kelchblatt.

He says that stamens may as well be contracted leaves, as the latter may be expanded stamens, which means that stamens and leaves are interchangeable. To amplify this idea, we may say that though the vegetable organs are very different, they are, in the end, in perfect unity, and are interchangeable one for another.

As we have seen in the several preceding quotations, GOETHE does not recognize any definite order in the formation or transformation of organs. His correct idea is, therefore, (though his opinions underwent some modification) to be explained by the theory of the mutual, participation and sharing of the genes, but not by the evolution theory (or the theory of phylogeny) which insists on a definite order in the formation of organs and species.

So far my interpretation of GOETHE. In the following pages, I shall quote the opinions of COHN and BIELSCHOWSKY. COHN's interpretation is as follows* :—

In Wahrheit aber ist der Bauplan der Pflanze unendlich einfach; die Pflanze entwickelt immer ein und daßelbe Organ, das an einem Stengelknoten sitzende Blatt, welches sie tausendfältig wiederholt, der Idee und Anlage nach immer das Gleiche, der Erscheinung und Entwickelung nach aber in mannigfaltiger Weise, bald gleich oder ähnlich, bald ungleich oder unähnlich ausgestaltet. Das Blatt gleicht dem Homerischen Meergeist Proteus, der sich in tausendfache Gestalten verwandelt und dadurch auch dem schärfsten vergleichenden Sinn entschlüpft.

According to COHN, it seems that GOETHE's *Blatt* is a foliage leaf. My opinion is that GOETHE's *Blatt* is a foliage leaf only in some particular cases, but in general it is a real entity to be conditioned in any way and to be transformed into any form according to the causal nexus.

BIELSCHOWSKY's interpretation may be resumed as follows** :— Carpels, sepals, petals, stamens and the like, or generally speaking, subordinate organs of the stem can be reduced to a fundamental organ. GOETHE's *Blatt* means the simplest fundamental organ which GOETHE called *Blatt* owing to the want of a word denoting a simpler organ than a leaf. In my

* COHN, F. — Die Pflanze (1896) p. 112.

** BIELSHOWSKY, A. — Goethe, sein Leben und seine Werke, II. p. 423 (1911).

opinion, GOETHE's *Blatt* does not imply either simplicity or complexity.

Quite apart from any partial treatment, GOETHE used *Blatt* or *Grund-organ* in several senses. He used it, at one time, as something denoting a fixed shape, but at another, as the real existence of organs or as a hypothetical most primitive element. He said that several organisms are to be reduced to an *Urpflanze*.

Now what is meant by *Urpflanze*?* At one time he meant a fundamental type, but at some other time, an ancestral form. He puts it as follows:—

> Das Wechselhafte der Pflanzengestalten hat in mir mehr und mehr die Vorstellung erweckt, die uns umgebenden Pflanzenformen sein nicht ursprünglich determiniert und festgestellt, ihnen sei vielmehr bei einer eigensinnigen, generischen und spezifischen Hartnäckigkeit eine glückliche Mobilität und Biegsamkeit verliehen, um in so viele Bedingungen, die über dem Erdkreis auf sie einwirken, sich zu fügen und darnach bilden und umbilden zu können. Kann das Geschlecht sich zur Art, die Art zur Varietät und diese wieder durch andere Bidingungen ins Unendliche sich verändern;....die allerentferntesten jedoch haben eine ausgesprochne Verwandtschaft.....

COHN**, quoting the above lines, interprets GOETHE's idea as expressing the thought that all species of plants can be reduced to an *Urpflanze*, and regards him as a precursor of Darwinism, antedating DARWIN by seventy years. COHN quoting a stanza of GOETHE's poem *Pandora* speaks of the poet's referring to "der Kampf ums Dasein". But, in my opinion, GŒTHE is merely speaking of the existence, in the human mind, of the animal instinct of combat. Anyhow, the distinctive feature of Darwinism, which is natural selection and the struggle for existence, can not be found clearly expressed in the poet's writings. As to this, COHN himself speaks as follows*** :—

> Den Kernpunkt der Darwinschen Lehre, daß die äußeren Lebensbedingungen erst im Laufe vieler Generationen durch natürliche Auslese die Umwandlung der Arten herbeiführen, finde ich bei GOETHE nicht ausgesprochen.

Yet, it seems GOETHE sometimes spoke of something like the evolution theory of the present day. He says:—

> Soviel aber können wir sagen, daß die aus einer kaum zu sondernden Verwandtschaft als Pflanzen und Tiere nach und nach hervortretenden Geschöpfe nach zwei ent-

* As to this question, readers are requested to refer to BIELSCHOWSKY's Goethe l.c. II. pp. 707–708.

** COHN, F. — Die Pflanze (1896) pp. 120–122.

*** COHN, F. — l. c. p. 151.

gegengesetzten Seiten sich vervollkommnen, so daß die Pflanze sich zuletzt im Baum dauernd und starr, das Tier im Menschen zur höchsten Beweglichkeit und Freiheit sich verherrlicht.

Here he clearly seems to have some idea of the theory of descent and he refers also to the divergence of characters.

BIELSCHOWSKY*, explaining GOETHE's idea as to the formation of species, opines that, as to the origin of species there are two possible theories, one is that all the species are created by God separately and independently, and the other is that all the species are formed by evolution from one single origin. His thought is, in other words, that the formation of species is explainable in two ways, either by the creation theory or by the evolution theory. And finally he concludes that, as GOETHE undoubtedly did not believe the creation theory, he must have had in mind the evolution theory.

My opinion is quite different from that of the above mentioned author. I think that there is, besides the two ways mentioned by BIELSCHOWSKY, one more way possible for the formation of species; that is one which is explainable by the participation theory to which I have above alluded. According to this theory, an innumerable number of species of organic beings have existed from the eternal past and will exist to the eternal future; they unite with or separate from one another, and produce many different organisms by different combinations of the genes; or they change by themselves, as the genes change. Thus, they come from the eternal past, changing their forms incessantly, and will continue to change forever.

GOETHE's idea is certainly not explainable by the creation theory. It is sometimes, as I have above stated, somewhat conformable to the evolution theory. Yet, the correct explanation of his ideas, according to my opinion, is given by the participation theory.

Conclusion and Additions.

GOETHE's opinions sometimes change. To interpret them, according to one of his ideas, which I believe to be correct, his *Blatt* in the case of vegetable organs, or *Urpflanze* in the case of plant species, is neither a

* BIELSCHOWSKY, A. — l.c. p. 437.

foliage leaf, in the case of the former, nor a primitive form, in the case of the latter. But it is the real entity which is itself an organ or species. We say this organ and that organ are different. Yet, they are different only in phenomenal appearances; in real entity, they are always similar. The same holds good as to species. If the proper conditions according to the causal nexus* are posited, it is possible to derive any organ or species whatever from any organ or species. Therefore, when we interpret GOETHE's *Blatt* or *Urpflanze* as the simplest fundamental organ or the most primitive organism, then the changes of organs or species are determinable and static. When we interpret, on the contrary, the *Blatt* or *Urpflanze* as a real entity, then the changes of organs or species are different in their courses according to the time and circumstances, and therefore are indeterminable and dynamic. Accordingly, the former interpretation is the view of evolution which finds the origin in one sole thing; while the latter is the view of manifold interrelation of organs or species, which finds the origin in every thing. According to the former view, the relation of organs or species is explainable by the evolution theory, and the system denoting the relation should be a static one. By the latter, on the contrary, the relation is elucidated by the participation theory, and the system should be a dynamic one. The former finds its proof in the sole way of the changeability of organs or species. But the latter finds realization in the manifold views of the mutability of organs or species.

The principle of natural classification should be founded on the latter views, namely:—on the participation theory, the dynamic system, and the manifold views of the mutability of species. As to the dynamic system of natural classification, I shall write more fully in the following paper.

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* By causal nexus, I mean the relation of innumerable causes, of which we know but a few. As a few causes of the formation of species, so far as are known to us, I may mention the following, namely:— the fixation of the characters acquired by the adaptation and direct influence of external conditions; crossing, and mutation. These are by no means independent, but closely inter-related one to the others. Cf. WEITSTEIN, R. R. — Handbuch der systematischen Botanik, p. 49.

As the author thinks that the acquirement of the tropical flora is the most important for the worker of the natural system of the flowering plants, he has decided to start for Indo-China where he will stay for one year to accomplish his study in the midst of the tropical forests, observing every changing aspect of the flora through all seasons. It is kindly requested that any correspondence regarding this paper on the natural system should be forwarded to the following address :—

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The Natural Classification of Plants according to the Dynamic System.

By

BUNZŌ HAYATA.

CONTENTS.

1. INTRODUCTION.

As I stated in the preceding paper, I have been reflecting on a system of natural classification to which my attention was drawn during the score of years that I devoted to the study of the flora of Formosa. Current opinion

demands that such a natural system be a static one[1] like BENTHAM-HOOKER'S or ENGLER'S, and that there is possible only one true ideal system, to which, however, we are as yet far from attaining, as but one phylogenetic tree is possible[2]. Much against my will, I have come to entertain strong doubts as to the effectiveness of the modern systematizers' effort to attain to the ideal system; and my twenty year's experience in systematic botany has steadily led me into quite a different channel of thought. This I now venture to make public, though I am aware that it will meet with a great deal of opposition.

All systematizers regard the natural system as a static one with a definite form and believe that all species, genera or families have their fixed natural positions, so as to be arranged between this and that, according to their natural relations. My idea is quite different from this current opinion. I regard the natural system as a dynamic one, changing with the view of the systematizer and subject to alteration, according to the way in which it is considered, and I believe that none of the species, genera or families has a fixed natural position, but has changeable positions, subject to alteration according to the criterion for comparison. It is neither natural nor necessary that a species should in all cases be arranged between this limit and that; but should be placed between this and that according to one view, or between another this and another that according to another view. In the present paper,

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1) Among the literature which treats of the principle of natural classification, I may mention the following works:—

DARWIN, C. — On the Origin of Species, (New York, 1890); Divergence of Character, and The Probable Effects of the Action of Natural Selection through Divergence of Character and Extinction, on the Descendants of a Common Ancestor, l. c. pp. 86–97; Classification, l. c. pp. 363–381.

HAECKEL, E. — Prinzipien der Generellen Morphologie der Organismen (Berlin 1906); Das natürliche System als Stammbaum (Prinzipien der Klassifikation), l. c. p. 390.

ENGLER, A. — Erläuterungen zu der Übersicht über die Embroyophyta Siphonogama, in den Natürlichen Pflanzenfamilien, Nachträgen zum II.–IV. Teil, (1897), pp. 358–380.

———, —. — Prinzipien der Systematischen Anordnung, im Syllabus der Pflanzenfamilien, siebente Auflage, Berlin, 1912.

HALLIER, H. — Provisional Scheme of the Natural (Phylogenetic) System of Flowering Plants, in the New Phytologist, Vol. IV., No. 7, (July, 1905), pp. 151–162.

———, —. — Ein Zweiter Entwurf des natürlichen (phylogenetischen) Systems der Blütenpflanzen, in den Berichte der Deutschen Bot. Gesellsch. XXIII., 2, pp. 85–91.

LOTSY, J. P. — Vorträge über Botanische Stammesgeschichte, I., Jena, (1907).

WETTSTEIN, R. — Handbuch der systematischen Botanik (Zweite Auflage, 1911); Allgemeiner Teil, l. c. pp. 1–49.

2) HALLIER, H. — Provisional Scheme of the Natural System, l. c. p. 152.

it is my desire to explain what I propose to call the dynamic system showing the natural relations of plants. In so doing, I shall principally refer to the Angiosperms, although I am perfectly sure that the result would be the same if I should refer to other classes of the vegetable kingdom.

2. Natural classification.

The first question which arises in the discussion of the present subject is "What is the natural classification of plants?" We answer that it is to classify plants according to their natural relations. In doing this, we first attempt to find whether the individuals which we are going to classify are separable according to this view but are united according to that view, i.e. to find the difference or resemblance between or among them. The second attempt in the course of natural classification is to unite the individuals into a small or large group or groups according to their resemblance, — into groups which should be subject to alteration as to their outlines as well as to their members, according as we look at the matter from this or that point of view. These, for the sake of simplicity, I propose to call dynamic groups. Then, in the third place, we should try to arrange the dynamic groups thus obtained, such as species, genera families or series, according to their natural relations, — to arrange them not in fixed orders, such as are determined in the systems of the present day, but to arrange them in orders that vary with different views, or simply speaking, to arrange them after a dynamic manner. In other words, to systematize plants according to their natural relations is to distinguish them one from another, to unite them through their resemblance, and finally to construct a dynamic system (so as to denote their mutual relations) changeable according to different views. In so doing, we shall try to understand the relations of all the members of the vegetable kingdom, or simply to understand the vegetable kingdom. This is, according to my idea, the principal object[1]

1) In the course of my study, I became more and more aware of the analogy between the classification of words and that of plants. An artificial system of plants is comparable to the ordinary dictionary in which words are arranged in alphabetical order. In constructing such a word list, we merely consult our own convenience; while another kind of dictionary like Roget's "Thesaurus" somewhat resembles my dynamic system, donoting real relations between plants

of systematic botany. As to the form which we predicate of the vegetable world, or as to how far we understand the latter in so doing, I shall speak in detail later on. But, for the present and for the sake of convenience, I shall merely give this general answer :—— Forms of plants are originally numerous; but in their real existence, they are all the same. They present different phenomena according to the different circumstances conditioned from eternity to eternity by the causal nexus. Their forms in different phenomena are naturally in inter-relation like the meshes of a net[2]; but not in a serial relation like the branches of a tree.

We have spoken just now of real existence and phenomena separately; but real meanings of both terms are comprehensible only in their perfect unity in oneness. In other words, species are quite similar in their basic characters; but they are different in their particular manifestations. Here again, as in the above case, both basic characters and particular manifestations are to be understood only in their unity — not separately.

3. Species.

We have spoken above of species but vaguely. Now, what is meant exactly by species. It must, of course, that the definition of species differs according to one's idea of what constitutes a species. My opinion is that a species is an individual presenting a certain manifestation in a certain gene-

themselves. As to the principal aim of systematic botany, it could not be more eloquently explained than by a sentence on the title page of the thesaurus. It runs :— "It is impossible that we should thoroughly understand the nature of the signs, unless we first properly consider and arrange the things signified" The more I look at Roget's work, the more I become astonished at the curious coincidence in the construction of the thesaurus and that of my present paper. His dictionary consists of four parts, namely :—1, introduction explaining the theory and principle upon which his classification is grounded; 2, plan of classification and synopsis of categories; 3, the thesaurus itself; 4, index. His introduction somewhat corresponds to the theoretical part of the present paper; his plan and synopsis exactly answer to the static classification taken in my paper as a framework or nucleus for the construction of my scheme; his thesaurus accords with my dynamic system and its explanation; and finally his index is constructed exactly like my index. This agreement shows, I sincerely believe, that things like words or plants are all under the rule of the same universal law.—Cf. Roget, P. M.—Thesaurus of English words and phrases, classified and arranged, so as to facilitate the expression of ideas and assist in literary composition (New Impression, 1918).

2) Roget, P. M. — l. c p. XXVIII. The same network-like relation of species is suggested in the following paper :— Lotsy, J. P. — Versuche über Artbastarde und Betrachtungen über die Möglichkeit einer Evolution trotz Artbeständigkeit, in Zeitschr. indukt. Abst. u. Vererbungs. VIII. Heft.—4, (1912) p. 331.

ration. Strictly speaking, it is very seldom that two individuals exist which are exactly the same. So, a species is generally represented by an individual. That species which is generally used in systematic botany is, therefore, not a species in my sense, but a group of several individuals that bear a close resemblance. For convenience' sake, the term species is in the present paper treated as a group like a genus or a family, only smaller than either of the two.

4. What the resemblance of species denotes.

Above, we have spoken of resemblance. But what is resemblance manifested in an individual or in a species? According to my opinion, the resemblance of individuals or species is not confined to cases of blood-relationship, but is manifested by the constitutional relationship. Now, what is meant by constitutional relationship?

In my former paper, I proposed the participation theory to explain the mutual relations of vegetable organs, individuals, or species. As the understanding of the mutual relations is in this case a most important matter, I trust I may be pardoned if I repeat the theory in the following pages.

5. The participation theory[1].

The theory is in fact but one theory, yet for convenience' sake I shall treat it as two, namely :— The theory of the mutual participation of the gene[2], and the theory of the mutual sharing of the gene. Literally speaking, the word "participation" seems to express a united action of genes to produce a certain result. Different genes participate in the effort to produce the resulting plant or plant organ. Different plants or plant organs on the other hand are found to share in the work of certain genes, or combination of genes; or perhaps we may say that the word "participation" points to the future, while the word "sharing" points to the work accomplished in the past. Thus, different genes participate in the work of producing a certain result, while different plants share with one another the work of certain genes. It must be

1) In formulating this theory, I have been influenced by a suggestion from Tendai's theory of mutual participation.

2) As to what is the gene, readers are requested to refer to [two similes given on pp. 103 and 104 of the present paper.

admitted, however, that my theory does not necessarily agree with that used in genetics, but is rather to be regarded as the latter theory expanded to the utmost limit[1].

Now, in order to help my readers to understand my theory, it is necessary to insist on the law of substance, i.e. the conservation of energy and the indestructibility of matter; that the universe in its real entity is ever the same —— the same now as in the past and as in the future; that it is only the phenomena which change from time to time; and that there can be neither increase nor decrease in its real entity. All individuals in the universe have close relations with the whole (i.e. the universe), and their real entities are something like the meshes of a net, whose therads extend in all directions through the universe; some of the threads being represented by chemical affinities or physical gravity. To divide the whole into parts is something like moving the interwoven threads of meshes hither and thither with one's fingers; for, though the whole is divisible into parts as it seems, these parts are still connected one with another by the threads. Individuals though they be called, they are not by any means in a condition of isolation, but rather are closely related to the whole. Thus, as a part moves, so moves the whole itself — that assemblage of many parts.

All individuals alike possess innumerable genes or factors[2]. The former present various phenomena according as, on the one hand, the latter are potent or latent; and on the other, according to the different combinations or seggregations of potent genes. Consequently, the relation of one individual to the others in phenomenal appearance is the relation of mutual participation or sharing of potent and latent genes in individuals.

Then, too, all genes in individuals may be apparent at one time and latent at another, and may change their characters, according to conditions.

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1) Cf. Morgan, T. H. — The theory of the gene, in Am. Nat. (1917) Vol. 51, pp. 513–520.

2) My idea is somewhat comparable to Vines' opinion that "the ultimate members, root, stem, leaf, may in this view be looked upon as potentially present even in the unicellular plant, just as man is potentially in the Amoeba; and their gradual unfolding is but a matter of time and the realisation of their inherent tendency to complexity, much as we have in the spore or the ovum the potentialities which we see realised as it grows into a plant." .... [Cf. Green, J.R. — A History of Botany, (Oxford 1909) p. 83].

As genes change, so change individuals. Yet, no new gene is ever created or produced; no existent gene ever vanishes. The genes now present are those that have existed from the eternal past and will continue to exist throughout the infinite future. The phenomena of an individual change from time to time, (the latter phrase of course being understood as meaning very long intervals of time). Such changes are brought about in the individual itself or by crossing with others. When the latter is the case, it sometimes does, and sometimes does not, follow the Mendelian law. Yet, for all that, individuals are always the same in their real entities. Genes present in individuals are not at all isolated, but are in close continuity in their essence. If we fix upon different colours to represent different genes, the latter present different hues, according to the conditions under which they are exposed at this time or that. Different genes are, therefore, exactly similar in their reat entities. Consequently, all individuals are to be regarded from two differen- points of view; one being that of universality, and the other that of particul larity. The universality of individuals follows from the unity of the genes contained in them, while the particularity of individuals is made comprehensible by the difference of the phenomenal appearances of the genes and the different combinations of the latter.

Now, in order to present to my readers more plainly the mutual relation of genes present in individuals, let us assume that individuals are composed of numerous rosaries formed of numerous, temporarily different, beads. Further, we will assume at the same time that the individuals are, as I have said before, something like knots caused by bringing close together here and there some of these entangled rosaries; also that the phenomenal appearances of the beads of the rosaries do not cease to change from time to time, as the beads are in close concatenation and in incessant flux in their essence; as the beads change, so do the phenomenal appearances of individuals (if we think of unlimited time). These beads are somewhat comparable to the genes of which I have spoken before; and they in the limited sense of phenomenal appearances are, at the same time, comparable to what are called genes by the student of genetics. It must be granted, however, that though I have compared the beads to the genes, yet the former denote only fixed qualities

of something generated, while the latter indicat generating qualities united with something generated.

I may here add another simile[1] as an explanation of my conception of individuals and genes. The universe is like a boundless net with innumerable millions of crystalline beads, each on a mesh of a different colour, each reflecting the images of other beads, and each consequently presenting different hues, according to the position of the observer. The beads present different hues, according as they are observed from this point or that. It is, however, only in their phenomena that they are different; in their real entities, they are all and ever the same crystalline beads. Each bead with innumerable millions of reflected images (say dots) of all varieties of colours (of which it must be understood some are visible, but some are invisible, according to the position of the observer) is something like an individual, and the images on each bead (the dots of different colours) correspond, so to speak, to the genes of which I have spoken above.

The most important point in my theory is that, however much we may have spoken both of real entity and of the phenomenal appearance, of individuals and genes, independently one from the other, yet the two should only be thinkable in their identity in oneness, and be inconceivable independently of one another.

As can be seen from the explanation given above, the first theory, that an individual is not to be considered as a character of a single quality, but as in reality a compound of different things generated by different genes, is called the theory of the mutual participation of the gene; the other theory, that the relation of individuals to others in their particularity is the relation of the mutual sharing of genes in phenomenal appearance (potent genes) in individuals, is called the theory of the mutual sharing of the gene.

According to these theories, all individuals or species are one and the same in their real entity, and that there are so many different species is due

1) In presenting this metaphor to my reader, I have been influenced by a suggestion from the Indra-nets, an allegory found in one of the Buddhist scriptures, which is called the Mahavaipulya buddha-ganda vyūha-sūtra (Kegonkyô). For this allegory, I am indebted to Professor J. Matsumura; I have not myself consulted the original scripture.

to the fact that genes contained in species present suitable temporary phenomenal appearances and suitable temporary combinations in agreement with the conditions which follow necessarily through the causal nexus. Constitutional resemblance of species is, therefore, manifested by the mutual sharing of genes possessed by them. Thus far having stated the real meaning of resemblance through the participation theory, I shall now try to explain what I have proposed as a dynamic system more concretely than I had done before.

6. The dynamic system.

Now, turning back our attention to what we have said before of the natural classification, we now see that our first attempt in the course of the latter is to find how species share their genes with others. Then, the second attempt is to group species into small or large groups according to the extent with which they have shared their genes with others[1], — into groups which should be subject to alteration, as to their limits as well as their members, according to whether we select this or that gene as a criterion for classification, — simply speaking, into dynamic groups. Finally, our third attempt is to arrange the dynamic groups thus obtained, such as species, genera or families, according to the relations of the mutual sharing of genes, — to arrange them, not in a fixed order, but in orders varying with views, or simply speaking to arrange them in a dynamic manner. The arrangement in dynamic forms is what I have spoken as a dynamic system. I shall explain it with examples further on.

Now, let us take four individuals representing four different species. These four are composed of numerous different genes; but amongst the latter genes only four, represented symbolically by **a, b, c** and **d**, are so far known to us. We shall try to systematize these species. Let a gene in parentheses denote a latent gene. Then, the four species may be symbolized as follows :— **(a) b c d, a (b) c d, a b (c) d** and **a b c (d).** One way of classifying these four is to group them into two groups, one containing the latent **(a)** gene and the

1) Lotsy, P. J. — Evolution by Means of Hybridization (1916) pp. 137–138.

other, the potent **a** gene. There are more three different ways of making up such groups of the same category by substituting (**b**) (**c**) or (**d**), in the place of (**a**). Also, there are certainly many other ways of grouping the four species so as to classify the species by taking a combination of genes as a criterion instead of a single gene, such as **a b, c b, a c, b c, c d,** or **b c d, a c d, a b d, a b c,** and so forth, — each way being in agreement with a natural relation according to each respective view. So the groups themselves are changeable or dynamic, according to whether we take this gene or that, or this combination or that, as a criterion for classification. One way of grouping can not be said to be more natural than others. Any one is natural so far as it is understood as dynamic and changeable according to views. But as soon as it is understood to be the only fixed, unchangeable one, admitting no other way, it becomes unnatural. I shall give a few examples of an actual instance, just below.

Velloziaceæ[1] (Liliifloræ): This family is referable to the Amaryllidaceæ according to one view, but it may be included in the Hæmodoraceæ according to another view. Moreover, it will prove to be a distinct family, if viewed from a different standpoint. So the family itself is a dynamic one, variously grouped according to the way of looking at the matter.

Myoporaceæ[2] (Tubifloræ): According to one view, this family should be divided into two, namely: — one, containing *Myoporum*, *Pholidia*, *Bontia* and *Zombiana*, which might be incorporated into the Scrophulariaceæ, — the other, represented by *Oftia*, which might be referred to the Verbenaceæ. Should this view be kept, then the Myoporaceæ must be disorganized and the limits and the members of the Scrophulariaceæ and Verbenaceæ should to some extent be altered. Truly, the plants referable to the above three families share their genes so as to be grouped in several ways according to views just as we have seen in the four symbolized species to which we have referred before. One way of grouping can not be said to be more natural than the others.

Loganiaceæ[3] (Contortæ): This group is regarded according to one view as a distinct family; but according to another view, as is proposed by BAILLON,

1) Nat. Pfl.-fam. II.—5, p. 125.
2) Nat. Pfl.-fam. IV.—3, b. p. 357.
3) Nat. Pfl.-fam. IV.—2, p. 26.

the family should be broken up and its genera should be referred respectively to the Apocynaceæ, Gentianaceæ, Solanaceæ Rubiaceæ, and Asclepiadaceæ. The limits of the families just referred to and their members to some extent vary, according as we hold this view or that.

Now, take examples of another kind. The Labiatæ[1] and Verbenaceæ[2] are, according to one way of looking at them, to be regarded as two distinct families; but in another way — which is that observed in the Borraginaceæ[3], which is established regardless of the position of the styles (whether the latter are terminal or gynobasic) — the former two families (i.e. Labiatæ and Verbenaceæ) should be united. Should the former view be held in the case of the Borraginaceæ, the latter family should be divided into two. But, such a division, in fact, could never be cansidered natural. The same is true of the separation of the Labiatæ from the Verbenaceæ. The two families are only artificially or superficially separated, but in reality, they are closely inter-related like the meshes of a net. This shows plainly that it is impossible to classify plants according to one sole view so naturally that the classification should denote their natural relations; that the latter relations are not to be understood in a static sense, but are only conceivable in dynamic senses; and finally, that natural groups are only thinkable in a dynamic sense.

Now let me give other examples showing how the natural arrangement or natural system of such natural dynamic groups should also be a dynamic one.

Julianiaceæ[4] (Julianiales): This group is closely related to the Anacardiaceæ and Juglandaceæ (the latter two families are widely separated from each other, so far as the existing system is concerned) in its resiniferous character, in its unisexual flowers with reduced envelopes, and in its solitary exalbuminate seeds. Other points of resemblance or similarity between the Julianiaceæ and the Juglandaceæ are the dissimilar male and female flowers, the broad stigmatic lobes of the styles and single coated ovules. In anatomical characters, the Julianiaceæ and Anacardiaceæ are very much alike, and the singular funicular development of the ovules, the seeds and embryo, are very much the same in both families.

1) Nat. Pfl.-fam. IV.—3, a, p. 205. 2) Nat. Pfl.-fam. IV.—3, a, 143.

3) Nat. Pfl.-fam. IV.—3, a, p. 80. 4) HEMSLEY, W. B.— On the Julianiaceæ: A New Natural Order of Plants, in Phil. Trans. Roy. Soc. Lond. Series B, CXCIX. pp. 169–197, Plates 18-24.

In the inflorescence and flowers, the relation of the Julianiaceæ and Fagaceæ is evident. The male inflorescence, the male flowers and pollen of *Juliania adstringens* are closely alike in texture, structure and form, to the corresponding parts in certain species of *Quercus*. The presence of several female flowers in a closed involucre is a characteristic of *Juliania* and *Fagus*, *Castanea* and *Castanopsis*. The seeds of both *Juliania* and the Fagaceæ are exalbuminate, and the cotyledons are epigæous in germination. If we lay great stress upon the characters of the reproductive organs in which there is agreement or similarity between the Julianiaceæ and Fagaceæ, or between the former family and Juglandaceæ, then the Julianiaceæ should be placed between the Juglandaceæ and Fagaceæ. On the other hand, if the anatomical characters are to be credited with superior value in classification, then the Julianiaceæ should be placed next to the Anacardiaceæ. Thus, the family may be put near the Juglandaceæ according to one view; but according to the other, it comes close to the Anacardiaceæ and is widely separated from the Juglandaceæ.

Salicaceæ[1] (Salicales): This group is closely related to the Batidaceæ in having a dimerous gynæceum, and also to the Myricaceæ and Juglandaceæ in having nearly naked or apetalous flowers. But on the other hand, the close relation of the Salicaceæ and Tamaricaceæ[2] (which stand far apart from the other, so far as the present system is concerned) is incontestable; the gynæceum, placentas, ovules, fruits and seeds, or even anatomical characters such as perforation of vessels, are very much the same in both families. If the presence or absence of sepals and petals are to be credited with superior value in classification, then the Salicaceæ should be brought near the Myricaceæ, Juglandaceæ or some such group. But on the other hand, if we attach importance to the structure of ovary, ovules, fruits, seeds or anatomical characters, then the Salicaceæ should find its place near the Tamaricaceæ of the Parietales.

Ranunculaceæ[3] (Ranales): This group bears some resemblance to the Magnoliaceæ, Anonaceæ and Nymphæaceæ in the inconstant number of the stamens, in the apocarpous gynæcea and in their spiral arrangement. It is

1) Nat. Pfl.-fam. III.—1, p. 35.
2) Nat. Pfl.-fam. III.—6, p. 291.
3) Nat. Pfl.-fam. III.—2, p. 54.

also to some extent related to the Berberidaceæ, especially in the integment of the ovules. At the some time, the Ranunculaceæ is closely allied to the Dilleniaceæ and Ochnaceæ (both of the Parietales), and in no less degree to the Rosaceæ, in the arrangement of the segments of the perianth and of the stamens, and also in the arrangement of carpels in the case of the last family. Further, the resemblance of the Ranunculaceæ and Alismataceæ, although the two families find places in the present system very far apart from each other, is incontestable, as can be seen in the indeterminably numerous stamens, in the apocarpous gynæcea and especially in the habits. The Ranunculaceæ are, therefore, besides being referable to the Ranales, may be referred respectively to the Rosales, to the Parietales, or even to the widely separated Helobiæ, according to the different ways of looking at them.

Anonaceæ[1] (Ranales): This group is certainly allied to the Magnoliaceæ in the floral structure and in the presence of "Ölgehalt." At the same time, it bears a close relation to *Maba* of the Ebenaceæ in its rimose albumen and in its trimerous flowers. Its natural position moves from one place to another, however far apart it may be from the former, according to the view of the systematizer.

Menispermaceæ[2] (Ranales): Certainly this group is assignable to the Ranales and can be placed next to the Berberidaceæ according to one view. But according to another view, it comes very close to the Sabiaceæ (Sapindales) in the structure of its flowers and fruit and even in its habit. In the male flowers, the resemblance between the Menispermaceæ and Dioscoreaceæ (Liliifloræ) is very striking and incontestable. Still more remarkable is the coincidence of the Menispermaceæ and Euphorbiaceæ (Geraniales) as is seen in the several genera of both families[1]. Its natural position is changeable from a place in the Ranales to one in the Sapindales and Geraniales or even to one in the Liliifloræ.

Kœberliniaceæ[3] (Rhœadales): This group is, according to one view, to be brought near the Saxifragaceæ (Rosales), but according to another view, it

1) Nat. Pfl.-fam. III.—2, p. 23.
2) DIELS, L. — Menispermaceæ, in das Pflanzenreich, IV.—94, p. 41.
3) Nat. Pfl.-fam. III.—6, p. 321.

is to be placed next to the Bixaceæ (Parietales). It is also to some extent comparable to the Simarubaceæ (Geraniales). Moreover, the resemblance between the Kœberliniaceæ and the Capparidaceæ is so close that the former is by some authors incorporated into the latter.

Dichapetalaceæ[1] (Geraniales): Some genera with gamopetalous and zygomorphous flowers of the same family are assignable to the Metachlamydeæ. But in other genera with polypetalous flowers, it agrees perfectly with the Euphorbiaceæ—Phyllanthoideæ (Geraniales). Its natural position therefore, shifts from one place to another, according to the different criteria applied.

Cyrillaceæ[2] (Sapindales): This group is related to the Ericaceæ in the habit and peculiar anthers of *Costœa* (Cyrill.). In another respect, it is undeniablly allied to the Aquifoliaceæ. HOOKER regards it as referable to the Anacardiaceæ, while ENGLER looks upon it as a distinct family assignable to the Sapindales.

Corynocarpaceæ[3] (Sapindales): This group is referred to the Berberidaceæ by JUSSIEU and SPRENGEL, while it is assigned to the Myrsinaceæ by others. VAN TIEGHEM places it near the Geraniaceæ.

Salvadoraceæ[4] (Sapindales): This should find its place among the Sapindales near the Celastraceæ, if we lay great stress upon the choripetalous genera, *Azima* and *Dobera*. But on the contrary, if the gamopetalous genera of the same family preponderate, then it should be placed close to the Oleaceæ.

Fouquieriaceæ[5] (Parietales): This is related to the Polemoniaceæ by the 3-celled ovary, by the more or less connate styles, and by the tube-like corolla with stamens at its base; but, in other characters besides those just givan, it is quite close to the Tamaricaceæ.

Winteranaceæ[6] (Parietales): In the presence of oil-cells in the cortex, pith and leaves, in the general structure of the xylem, especially in the tracheids with bordered pits in wood-prosenchyma and in the inconstant number and spiral arrangement of the perianth-segments, this group comes very close to the Magnoliaceæ (Ranales). On the other hand, if the connate

1) Nat. Pfl.-fam. III.—4, p. 347. 2) Nat. Pfl.-fam. III.—5, p. 180.
3) l. c. Nachtr. I. p. 217; Nachtr. III. p. 197. 4) Nat. Pfl.-fam. IV.—2, p. 17.
5) Nat. Pfl.-fam. III.—6, p. 298, and Nachtr. III. p. 228. 6) Nat. Pfl.-fam. III.—6, p. 316.

stamens, coupled with the presence of the oil-cells in the place just mentioned, are to be credited with superior value in classification, then the Winteranaceæ should be placed next to the Myristicaceæ (Ranales). But in other respects, it is altogether related to the Violaceæ and Flacourtiaceæ (Parietales).

Passifloraceæ[1] (Parietales): This group is closely allied to the Malesherbiaceæ (Par.) and Turneraceæ (Par.) in its general aspects. But, on the other hand, if the receptacle and its effiguration, and the often stalked ovary are especially taken into consideration, then it is comparable rather to the Thymelæaceæ (Myrtifloræ). Also in a certain respect it comes near to the Cucurbitaceæ.

Achariaceæ[2] (Parietales): If the superior ovaries, parietal placentas, and the presence of albumen are credited with superior value in classification, then it should be placed quite close to the Passifloraceæ. But, if the gamophyllous corolla preponderate, when weighed against the above mentiōned characteristics, then the Achariaceæ would come next to the Cucurbitaceæ.

Oleaceæ[3] (Ebenales): This group is closely allied to the Loganiaceæ and to the Rubiaceæ; but on the other hand, it is in no less degree comparable to the Celastraceæ and Salvadoraceæ (both of the Sapindales).

As can be clearly seen in the above examples, a family is placed in one position by authors with one view, while it is taken to another by those with another view. The present systematic problem in current opinion is to decide whether it is better or more natural to place it near this or near that; or which characteristics preponderate over others. But in my opinion, the problem is seen to be quite wide of the mark, so soon as the real state of things is considered. The families just considered are such groups, as the symbolized species above referred to, whose natural relations are only conceivable according to the dynamic view. A family comes close to this in one view, but in the other, it goes to that, just as a child playing with its mates. The child changes its company at random, but the plant shifts its place according to the law of natural relations.

A natural system denoting the natural relations of families should,

1) Nat. Pfl.-fam. III.—6, a, p. 78. 2) Nat. Pfl.-fam. Nachtr. I. p. 257.
3) Nat. Pfl.-fam. IV.—2, p. 4.

therefore, be a dynamic system[1]. The same is true as to the system of the genera in a family. This is very clearly seen in larger families such as the Gramineæ, Rosaceæ, Saxifragaceæ, and others. In the Gramineæ especially, the genera never stand in a serial relation. There are, perhaps, not two tribes which can be sufficiently distinguished one from the other by a single characteristic. It is by a combination of several characteristics, that they are usually divided. Of all the tribes of the Gramineæ limited by the authors of both ancient and modern times, none is said to have been exactly differentiated from the others[2]. But, on the contrary, they are closely inter-related and share different characteristics among themselves. Accordingly, they, tribes as well as genera, change their limitations and members in accordance with different views. Their system must, therefore, necessarily be a changeable one. The same is true as to the species belonging to a large genus. They always stand in an inter-relation, but not in serial relation. Such a system of treating and denoting inter-relations in the dynamic views of species, genera or families, I propose to call the dynamic system in the natural classification of plants. Although the same system can be applied to the whole vegetable kingdom, I shall, in the present paper, limit myself to the Angiospermæ which group is more familiar to me than other groups.

Those who insist upon the view that the natural system should be a static one and that, therefore, only one real system is possible still believe the evolution theory in the sense that, while species have been serially developed, they have always retained diverse in their characters. On the other hand, those who think that it is not always necessary that species should be developed serially or invariably exhibit divergent characters; and who also beleve that[3] species are not only able of themselves to turn out different species through

1) I desire to call my readers' attention to the fact that the statements about the dynamic system are to be held only in the case of a comparison of members (plants) which should all belong to the same group or should all belong to different groups of the same rank. The statements are not to be applied in the case of a comparison of members, some of which belong to the same group, while others belong to different groups. In the latter case, the relations of the members belonging to the same group are less dynamic than those of members belonging to different groups. For example, in comparing the plum, cherry, and cucumber, we see that the relations between the former two are always more close (or less dynamic) than those between either of the former two and the cucumber, even though we consider them from every different point of view.

2) Nat. Pfl.-fam. II.—2. p. 16.

3) WETTSTEIN, R. R. — Handbuch der Systematischen Botanik, p. 49.

adaptation or mutation, or similarly to produce many others by crossing, but also are formed from within or without by other means which are as yet unknown to man, — such minds can neither recognize the existence of the phylogenetic tree, nor believe in the possibility of phylogenetic classification. Moreover, for those who understand the real state of the natural relations of families as illustrated by the examples which we have just given above, it is impossible to believe the existence of any determined static natural system such as modern systematizers are unanimously struggling to make.

There have hitherto been several systems[1] which have been called natural. But, all of them are static. The two most used by students at the present time are the systems of BENTHAM-HOOKER and of ENGLER. In both of these, speaking generally (certainly there are exceptions), one first group (say a family) is connected with a second by a relation established according to a certain view, while the latter is connected with a third by a relation established according to another view. The members of this part of the system are, therefore, considered from one point of view; but those of that part of the same system are arranged according to another point of view. For example, the members of the Monoctyledones are arranged regardless of whether they are gamopetalous or polypetalous; while those of the Dicotyledones are arranged on the basis of the said characters[2]. Another example is found in the classification of the Tubifloræ. Some families of the latter series are on the one hand classified on the basis of whether they have or have not eremus; while others of the same series are, on the other hand, arranged on the basis of whether their flowers are zygomorphous or actinomorphous[3]. Accordingly, the present systems certainly cannot be taken as denoting natural relations of the members in every respect; nor are they systems that denote relations

1) Among the systems which have been established by great authors, I may mention the following, namely:—The system of LINNAEUS (1735); that of A. L. DE JUSSIEU (1789); that of AUG. PYR. DE CANDOLLE (1819); that of ST. ENDLICHER (1836-1840); that of A. BRONGNIART (1843); that of BENTHAM and HOOKER (1862-1883); that of ALEX. BRAUNS (1864); that of AD. EICHLER (1883). That of VAN TIEGHEM (1898); that of ADOLF ENGLER (1912).

2) ENGLER, A. — Erläuterungen zu der Übersicht über die Embryophyta siphonogama, in Nat. Pfl.-fam. Nacht. I. p. 371.

3) ENGLER, A — l. c. p. 370.

of members according to one and the same view. When judged quite apart from any partial treatment, even the best system at present known as such, while pretending to follow the mutual relations of A. B. C. D........., in reality, merely denotes the relation of A—B according to one view; that of B—C according to another view; and that of C—D according to still another view; and that of some remote members, such as C and K, very faintly, if at all. The construction of such a system is something like sewing a fox's skin to a lion's. Figuratively speaking, such a system is comparable to a marquetry picture of a mountain, one piece of which is taken from a picture of the mountain viewed from the south, a second piece as viewed from the north, a third as viewed from the east, and so on; while the real natural system is to be likened metaphorically to a model of the mountain itself. Such a model, if seen from different sides, presents different phases, as a real system denoting real natural relations should; but, on the contrary, the marquetry picture shows but one appearance like the system at present known to us. The phase of the former is dynamic, while that of the latter is static. If we may be allowed to call such a static system "natural", as we usually do, then the systems of LINNAEUS, ANTOINE JUSSIEU, DE CANDOLLE, ENDLICHER, BRONGNIART, BENTHAM-HOOKER, VAN TIEGHEM, ENGLER, HALLIER or even what TREUB has proposed, should be regarded as natural. On this occasion, however, it can not well be said that one system is natural while the others are artificial. All systems should be true and natural regarding one part according to a certain view, but regarding another part by another view. But, if by natural system we mean, as we ought, that one in which we can see all the natural relations of all the members of the system (according to any view and between any two members), then it must be quite different from the systems of the great authorities above mentioned. It follows that the above-named systems are not natural but artificial, and have been established merely for the sake of convenience. We can not, therefore, go so far as to say that this system is more natural than that; but rather that the former is more convenient than the latter. In this sense, even ENGLER's system, which is at present regarded as the most natural, is nothing more than a very convenient system. In the following pages I shall try to give a full account

of my reasons for this statement, while reviewing and criticizing ENGLER'S principle of natural classification and his system.

7. REVIEW OF, AND CRITICAL REMARKS ON ENGLER'S PRINCIPLES AND HIS SYSTEM OF THE ANGIOSPERMS.

a. ENGLER'S PRINCIPLES OF SYSTEMATIC ARRANGEMENT[1].

Speaking conclusively, his principles are those of his system, but not those of what I shall call the natural system. I shall now take up this matter section by section. In the first section ENGLER says:—

> Das Streben der wissenschaftlichen Klassifikation der Pflanzen oder der botanischen Systematik ist zunächst darauf gerichtet, die Pflanzenformen nach ihrer natürlichen Verwandtschaft in Gemeinschaften niederen und höheren Grades (in Arten, Gattungen, Familien, Familienreihen oder Ordnungen, Klassen, Abteilungen) zu gruppieren.[2]

Here he speaks of "natural affinity" (Natürliche Verwandtschaft), the true meaning of which is certainly blood-relationship. But what systematizers can treat directly or are treating practically is constitutional resemblance instead of blood-relationship. The latter is to be found directly and exactly only in a census register or in such a case as ENGLER refers to in § 2; it can not be ascertained generally. We are, therefore, obliged only to infer blood-relationship through the observations of constitutional resemblances, assuming that the former is in agreement with the latter (but, in reality, they need not agree). As the resemblances are, according to the participation theory which I have referred to before, manifested by the participation of genes, ENGLER'S affinity-group (Verwandtschaftkreis) is nothing but a collection of members marked by one or more genes shared in the members. The group is, therefore, as I have said before, a dynamic one changeable according as different genes are taken as criteria. Here, it is clear that ENGLER undoubtedly means by affinity-group a static one unchangeable no matter in what way it is regarded. According to my way of thinking, the existence of such a definite group is impossible. Now, let us think of a case in which we could

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1) ENGLER, A. — Prinzipien der Systematischen Anordnung, im syllabus der Pflanzenfamilien, 7-Aufl. (1912) pp. VIII—XXII.

2) ENGLER, A. — l. c. p. VIII.

obtain an affinity-group by the direct observation of natural affinity, as ENGLER says in § 2. Such groups, according to his statement[1], exist only in species, genera, families or in series. In other words, natural affinity is to be found between one individual and another individual belonging to the same species, between species and species belonging to the same genus, between genus and genus belonging to the same family, between family and family belonging to the same series; but there is generally no phylogenetic relation between series and series. Consequently, in his system, species, genera, families are, as far as his statement is concerned, arranged according to their natural affinity; while the series are not so arranged. It follows, therefore, that the series are arranged, according to their degree of advancement, or according to their simplicity or complexity, or according as they are primitive or reduced. His system is locally, in this part or that, natural in the sense that it denotes a certain relation of blood-kinship or a constitutional resemblance; but his system, taken as a whole, is an artificial system, the series of which are arranged according to their degree of advancement, or to some such idea. As for the recapitulation theory which is given by him in § 2, as a means of determining natural affinity, it is in many cases especially in plants not to be relied upon[2]. The other experimental method given by him is something that can be seen only in some few special cases. He says that it is necessary to ascertain affinity through the study of the development history. I think that is truly indispensable for finding the mutual relations in the case of development; but I think it is equally necessary that we should take into account the resemblance in the adult stage; the natural relation of young forms is sometimes different from that of adult forms, so that the real natural relation is only conceivable in its dynamic phase. He writes as follows[3] especially for the higher plants:—

> Dagegen sind wir bei der Feststellung der Verwandtschaft höherer Sippen genötigt, auf indirektem Wege die natürliche Verwandtschaft zu ermitteln, und dabei leicht irrtümlichen Auffassungen ausgesetzt.

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1) ENGLER, A. — Erläuterungen, l. c. p. 362.

2) SCHOUTE, J. C. — Die Stelär-Theorie, p. 138 (P. Noordhoff Groningen, 1902).

3) ENGLER, A. — l. c. p. IX.

But, this can be accepted only in the case where one believes that species are formed only through the fixation of characters acquired by adaptation or direct influence, which characters are ever diverging. When we think of several other causes of the formation of species, such as crossing and mutation, we can not but be forced to conclude that it is impossible to arrive at blood affinity through indirect methods. The latter conclusion can be easily understood by one who accepts the participation theory. It is only in some special case that we can see blood-relationship through the study of resemblance[1]. As blood-relationship is of course one of the natural relations manifested by organisms, it should certainly appear in one phase of the dynamic system. But, it can not be definitely stated that blood-relationship is the only criterion for constituting a natural system. ENGLER goes on to say[2]:

> Es hat die Erfahrung gelehrt, daß äußerlich oft sehr ähnliche Organismen nur eine entfernte Verwandtschaft besitzen.

This is indeed true. That is why I should say that a real natural relation is so and so in external form, but at the same time is manifested differently in blood-relationship. In this respect, his opinion differs from mine. Again he says[3]:—

> So ist man zu der Erkenntnis gelangt, daß einzellige, kugelige, also äußerlich sehr ähnliche Organismen nicht bloß sehr verschiedenen Familien, sondern auch verschiedenen Klassen und Abteilungen angehören können.

In my opinion, this will not do. According to my idea, if organisms are very similar in their external forms, they should be taken into the same group. In some special case where we know their blood-relationship exactly, it will be all right to arrange them according to this criterion. The latter arrangement is sometimes, as ENGLER states above, very different from that made according to the standard of external forms. But this does no harm to our natural system. The difference follows from the difference in the criterion. The natural system should, therefore, be a dynamic one which manifests different phases when viewed from different standpoints. Further he proceeds to say:

> So gelangt man zur Feststellung von Verwandtschaftskreisen, deren systematischer Rang lediglich danach bestimmt wird, bis zu welchem Grade

1) LOTSY, P. J. — l.c. 2) ENGLER, A. — l.c. p. IX. 3) ENGLER, A. — l.c. p. IX.

> der Entwicklung ein durch gewisse Eigenschaften oder Dominanten charakterisierter Typus gelangen kann, d. h. welcher Progressionen er fähig ist.

From this we see that his affinity-group is one that is determined only in so far as it accords with one view of "certain characters." But, we shall see quite different affinity-groups established, as I have before stated, when viewed from different standpoints. Then he remarks :—

> Wir erkennen hierbei, daß vielfach parallele Entwicklungsreihen auftreten und daß man sich hüten muß, die Parallelercheinungen mit den eine Sippe charakterisierenden Erscheinungen auf gleiche Stufe zu setzen.

In the above quotation, he states that characters of plants observed in the present vegetable world are referable to two different categories, namely :—1, those denoting parallel advancement in different series or classes; 2, those denoting to what series they belong[1]. In my estimation, it is impossible to regard different characters as necessarily and decidedly denoting such different meanings. In my opinion, there can be no such absolute difference between the characters. ENGLER's statement is only for convenience. Even if we admit the two kinds of characters for convenience' sake, they are not peculiar (proper) to themselves but are interchangeable. If characters, regarded by ENGLER as representing those of the first category, are taken by another author as those of the second, the other characters regarded by ENGLER as those of the second should, in their turn, be taken by the other author as those of the first category. In fine, to ascribe different chararters to the two different categories is a mere expedient to furnish arguments for a system established on the assumption of phylogeny. Now, let us consider the matter by examples. According to ENGLER's system, such characters of the Umbellifloræ, as valvate æstivation, a reduced calyx, andrœceum consisting of one whorl of five stamens, two-celled ovary with a few ovules, are all regarded as belonging to the first category, since the same characters are found in the Rubiales; while such a character of the Umbellifloræ as that represented by polypetalous flowers is regarded as of the second category, as a character of the Rubiales represented by gamopetalous flowers is likewise treated. In other

1) Characters of this second category show the blood connection within a group, but not between groups.

words, characters, such as valvate æstivation, reduced calyx or the like, found in both the Umbelliforæ and Rubiales show that they are in the same stage of parallel advancement; while the polypetalous flowers in the former series indicate that it belongs to the same class as the Archichlamydeæ, and the gamopetalous flowers of the latter series shows its attachment to the Metachlamydeæ. This is a view that recognizes no relationship between the two series (Umbelliforæ and Rubiales)[1]. On the other hand, according to another opinion which suggests some affinity between the Umbelliforæ and the Rubiales, and therefore seems to me to be more thoughtful than the preceding one, the characters regarded by ENGLER as those denoting their parallel advancement would most probably be characters indicating a blood-relationship (like those of the second category) between the two series[2]. If this view be accepted, then such characters as polypetalous or gamopetalous flowers which were regarded a little while ago as those denoting affinity are now in their turn to be taken as indicating a parallelism between the Rubiales and other series of the Metachlamydeæ such as the Ericales or Primulales.

In § 3, he says[3]:—

> Zu einer Familie werden einerseits diejenigen Formen vereinigt, welche in allen **wesentlichen** Merkmalen des anatomischen Baues, der Blattstellung, des Blütenbaues, der Sporenbildung oder der Frucht- und Samenbildung eine augenfällige Übereinstimmung zeigen, wie z. B. die Bakteriaceen oder Stäbchenbakterien, die Lamellenschwämme oder Agaricaceen, die Armleuchtergewächse oder Characeen, die Polypodiaceen, die Gramineen, die Iridaceen, die Orchidaceen, die Cruciferen, die Umbelliferen, die Borraginaceen, die Labiaten, die Compositen, — anderseits diejenigen Formen, welche zwar untereinander in einzelnen der genannten Verhältnisse Verschiendenheiten zeigen, aber doch durch ein gemeinsames Merkmal, sei es der Zellbeschaffenheit, des anatomischen Baues, der Blüte oder Frucht, verbunden sind. Hierbei erscheint die Zusammengehörigkeit um so sicherer, je mehr die Verschiedenheiten schrittweise auftreten.

In the latter half of this sentence, it is stated that some groups are marked by a certain character, which is taken as the sole criterion, and by no other character. In this case, it can be easily understood that the group itself showing a natural relation is changeable and therefore dynamic. It shows a different aspect as to its limit and members, according to the criterion, for

1) ENGLER, A. — Syllabus der Pflanzenfamilien (1912) p. XXVII.

2) Nat. Pfl.-fam. IV.—4, p. 13; III.—8, pp. 15 and 111.

3) ENGLER, A. — l. c. p. X.

which we may take this character at one time or that at another. On the other hand, groups shown in the first half of the same quotation are characterized by many characters (by these and at the same time also by those); their limits and members do not change so manifestly as in the case of the former groups, although the characters taken as standards vary. Speaking generally, there are, to be sure, some groups which are more dynamic and others which are less dynamic. For examples, the Velloziaceæ, Loganiaceæ, Myoporaceæ, Labiatæ, Verbenaceæ, Euphorbiaceæ are more dynamic; while the Gramineæ, Orchidaceæ are less dynamic groups. The latter certainly are unchangeable within the limits of the variation of certain criteria; but they can not be exempted from being more or less dynamic, when all considerations known as well as unknown to us are taken into account, as we shall see later on in the dynamic system and the explanation of it, to be given in this paper.

Now, let us take the words, dynamic and static, in a comparative sense and by "static" let us mean what is less dynamic. Then, there are two ways of expressing the standing of all groups, namely:—1, to regard all groups as static forms, and treat dynamic forms as exceptional cases; 2, to regard all groups as dynamic forms and to treat static forms as exceptions. Of these two methods, the latter seems to me to be preferable to the former. The reasonableness of my preference will be seen when we come to explain the dynamic system. Speaking generally, what I call a less dynamic group is mostly represented by groups of the lower class, such as species or genera, and what I call the more dynamic is illustrated by groups of the higher class, such as families or series. Such groups as the Orchidaceæ and Gramineæ, just given as examples of less dynamic groups, somewhat correspond to what we would have regarded as genera or the like, when compared with more dynamic groups such as the Euphorbiaceæ or Myoporaceæ.

What ENGLER says in § 4, may be taken as an illustration of the inconstancy of groups. In § 7[1], he goes on to say:—

> Die Erfahrung, daß einzelne Merkmale zur Charakterisierung größerer Pflanzengemeinschaften verwendet werden können, andere nicht, fuhrte zu der Annahme von

1) ENGLER, A. — l. c. p. XI.

wesentlichen und unwesentlichen Merkmalen. Es hat sich jedoch herausgestellt, daß selbst sehr wesentliche Merkmale bei den durch sie charakterisierten Gruppen nicht immer konstant auftreten; es hat sich ferner herausgestellt, daß viele Merkmale in der einen Pflanzengruppe wesentlich, in der anderen unwesentlich sind, so z. B. Art der Konidienbildung, Blütenfarbe, Sekretzellen, Sekretgänge, Milchsaftschläuche, Zahl der Kotyledonen, Nebenblätter, Blattstellung, Verwachsung, von Blumenblättern usw.

In the above passage, he tells us that there are "wesentliche" and "unwesentliche" characteristics. Now let us consider the true meanings of these two terms. What are called important characteristics clearly must include those which were taken voluntarily or conventionally as the criteria for the erection of a group and for determining the limit of the latter, or those which come in linkage with the above qualities. In other words, they designate those which characterize what we had habitually regarded as a group. The term "unwesentliche" points out those characteristics which are just the opposite of the above qualities. Thus interpreted, there could originally have been no such difference in characters as is expressed by the words "wensentliche" or "unwesentliche." All characters show natural relations in respect of themselves, no matter whether they be taken or not taken as criteria or whether they come or do not come into linkage relations with the other features, that is to say, regardless of whether they characterize or do not characterize the conventional groups. They should all, therefore, be taken into account in any system denoting natural relations.

What ENGLER states in § 8[1], may be taken as an illustration of the statement that he applies the term "wesentliche" to a character that is helpful in justifying the present system, and that he applies "unwesentliche" to one that stands in the way of our doing so.

His statement in § 9[2] is in my opinion altogether impossible. For phylogenetic development is not a matter that can be made clear through a comparison of the plants of the present age; and even if it could be done, the difficulty would remain that the order of progression or the stage of development is not the same for all plants, but is possibly different for every

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1) ENGLER, A. — l. c. p. XI. 2) ENGLER, A. — l. c. p. XII.

different plant, according to time and circumstance, as I explained in a former paper[1].

Paleontalogy to which ENGLER refers in § 10 and § 11 is not so very important for the classification of the plants of the present age, as it is thought to be by those who believe that the formation of species is only explainable according to the evolution theory. If we think of the innumerable causes[2] of species' coming into existence, such as mutation, crossing, fixation of characters acquired in the course of adaptations, and many others yet unknown to us, we cannot but hesitate to attach importance to paleobotany.

In § 12, he distinguishes two characteristics of adaptation and of organization, and states that the latter is the quality which should be credited with a superior value in classification. This, in my judgement, will not do. We distinguish this as an adaptation - character, and that as an organization-character; but the demarcation is only for convenience. Not only is there no absolute difference between the two, but on the contrary they are in close inter-relation. For classification, both characters should be taken into consideration. This, to be sure, makes the existence of a static system impossible. To this point we shall return later on.

Further, he makes reference in § 13[3] to the difficulty of determining the order of the arrangement according to progression and states that the natural system will always be subject to alteration, as it always has been. The former reference is something like an approach to my idea of the impossibility of determining the serial orders; while the latter statement may be taken as partly illustrating my opinion that the natural system can only be brought to realization in its dynamic changeable form.

What he speaks of in § 14[4] is nearly the same as the statements referred to in § 2, and the remarks which I have made above will do as well for the present case.

In § 15[5], he refers to the systematic importance of anatomical characters,

1) HAYATA, B. — An Interpretation of GOETHE's *Blatt* in his "Metamorphose der Pflanzen", as an explanation of the principle of natural classification, in Ic. Pl. Formos. X. pp. 75—95.

2) WETTSTEIN, R. R. — Handbuch der systematischen Botanik p. 49.

3) ENGLER, A. — l. c. p. XII.

4) ENGLER, A. — l. c. p. XIII.

5) ENGLER, A. — l. c. p. XIII.

on the ground that the latter denote the attachment of members to this or that group. In illustration he points out such characters as trichome, the subsidiary cells of stomata, and the presence of bicollateral bundles. But, all these anatomical characters, clear and valid as they are, do not appear in linkage relation with the floral remarks of families, some of the former characters being presented in quite different families, as we shall see in the accounts given in the foot note[1]. Consequently, if we group plants according to the criterion of anatomical characters, then we shall surely have quite different families from those which we have at present, which are mostly established according to the standard of floral structure. Just here, we see the great difference between a system as viewed from the stand-point of anatomy and the same as viewed in a consideration of the reproductive organs. True real natural relations would be and ought to be found in this difference. A natural system is, figuratively speaking, something like a system of simultane-

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1) The following notes are taken from SOLEREDER'S Systematic Anatomy Vol. II. pp. 1079–1167

STOMATA HAVING NO SUBSIDIARY CELLS AND CONFORMING TO THE CRUCIFEROUS OR RANUNCULACEOUS TYPES are found in: Ranunculaceæ and others in the Ranales; Papaveraceæ in the Rhœadales; Sarraceniaceæ in Sarracenials; Violaceæ and others in the Parietales; Polygalaceæ and others in the Geraniales; Caryophyllaceæ and others in the Centrospermæ; Malvaceæ and others in the Malvales; Celastraceæ and others in the Sapindales; Rhamnaceæ and others in the Rhamnales; Leguminosæ and others in the Rosales; Droseraceæ in the Sarraceniales; Myrtaceæ and others in the Myrtifloræ; Cucurbitaceæ in the Cucurbitales; Cornaceæ in the Umbellifloræ; Caprifoliaceæ in and others in the Rubiales; Compositæ and others in the campanulatæ; Ericaceæ and others in the Ericales; Plumbaginaceæ in the Plumbaginales; Primulaceæ and others in the Primulales; Ebenaceæ and others in the Ebenales; Gentianaceæ and others in the Contortæ; Borraginaceæ and others in the Tubifloræ; Amarantaceæ and others in the Centrospermæ; Polygonaceæ in the Polygonales; Nepenthaceæ in the Sarraceniales; Aristolochiaceæ in the Aristolochiales; Piperaceæ and others in the Piperales; Monimiaceæ and others in the Ranales; Thymelæaceæ and others in the Myrtifloræ; Santalaceæ in the Santalales; Balanopsidaceæ in the Balanopsidales; Ulmaceæ and others in the Urticales; Juglandaceæ in the Juglandales; Myricaceæ in the Myricales; and some of the Fagales.

STOMATA WITH SUBSIDIARY CELLS, LYING PARALLEL TO THE PORE, occur in: Calycanthaceæ, Magnoliaceæ and others in the Ranales; Violaceæ and others in the Parietales; Portulacaceæ in the Centrospermæ; Linaceæ and others in the Geraniales; Chailletiaceæ; Corynocarpaceæ and others in the Sapindales; Leguminosæ and Rosaceæ in the Rosales; Cactaceæ in the Opuntiales; Umbelliferæ and others in the Umbellifloræ; Rubiaceæ and others in the Rubiales; Ericaceæ and others in the Ericales; Styracaceæ in the Ebenales; Apocynaceæ, Asclepiadaceæ and others in the Contortæ; Convolvulaceæ, Bignoniaceæ and others in the Tubifloræ; Polygonaceæ in the Polygonales; Chloranthaceæ in the Piperales; Proteaceæ in the Proteales; Loranthaceæ and others in the Santalales; Casuarinaceæ in the Verticillatæ; and Salicaceæ in the Salicales.

STOMATA WITH SUBSIDIARY CELLS, LYING TRANSVERSELY TO THE PORE, occur in: Caryophyllaceæ

ous equations containing many unknown quantities, x, y, z,.... Different phases of the natural system viewed from different standpoints are to be likened to different equations showing the different relations of the unknown quanties; and the natural relations which we are struggling to demonstrate in constructing a natural system are somewhat similar to the values of the unknown quantities which satisfy the equations. This metaphor, I think, makes sufficiently clear that a natural system should be a dynamic one.

The characters which ENGLER refers to in §§ 16, 17, 18, and 19[1], as those denoting the stages of advancement, are all the respective peculiarities of the plants and they should certainly be taken into account.

In § 20[2] he states that the whorl arrangement of floral elements usually occurs in correlation with the inferior ovary or zygomorphy. It is true that the more the characters come in linkage, the less dynamic becomes the system, which shows the natural relations of the plants compared. Conse-

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in the Centrospermæ; Melastomaceæ in the Myrtifloræ; Lentibulariaceæ and others in the Tubifloræ; and Plantaginaceæ in the Plantaginales.

SECRETORY CELLS, OF VARIOUS SHAPES, WITH RESINOUS (OILY), LATEX-LIKE OR OTHER CONTENTS, are found in the following families respectively: Calycanthaceæ and others in the Ranales; Papaveraceæ and others in the Rhœadales; Bixaceæ in the Parietales; Polygalaceæ and others in the Geraniales; Sapindaceæ and others in the Sapindales; Leguminosæ and others in the Rosales; Myrtaceæ and others in the Myrtifloræ; Cornaceæ in the Umbellifloræ; Rubiaceæ and others in the Rubiales; Compositæ and others in the Campanulatæ; Plumbaginaceæ in the Plumbaginales; Primulaceæ and others in the Primulales; Apocynaceæ and others in the Contortæ; Convolvulaceæ and others in the Tubifloræ; Aristolochiaceæ in the Aristolochiales; Piperaceæ and others in the Piperales; Myristicaceæ and others in the Ranales; Euphorbiaceæ and others in the Geraniales; and Moraceæ in the Urticales.

ELONGATED SECRETORY SACS are found in the Trochodendraceæ and others in the Ranales; Anacardiaceæ in the Sapindales; Crassulaceæ and others in the Rosales; Passifloraceæ in the Parietales; Rubiaceæ and others in the Rubiales; Compositæ and others in the Campanulatæ; Polygonaceæ in the Polygonales; Myristicaceæ in the Ranales; and Euphorbiaceæ in the Geraniales.

TANNIN-IDIOBLASTS are found in the Violaceæ and others in the Parietales; Geraniaceæ in the Geraniales; Rhamnaceæ and others in the Rhamnales; Leguminosæ in the Rosales; Melastomaceæ; in the Myrtifloræ; Rubiaceæ in the Rubiales; Pirolaceæ in the Ericales; Gentianaceæ in the Contortæ; Solanaceæ and others in the Tubifloræ; Polygonaceæ in the Polygonales; Aristolochiaceæ in the Aristolochiales; Piperaceæ in the Piperales; Euphorbiaceæ in the Geraniales; Moraceæ in the Urticales; and Ceratophyllaceæ in the Ranales.

INTRAXYLARY PHLOËM is found in the following families: Vochysiaceæ in Geraniales; Combretaceæ, Myrtaceæ, Melastomataceæ and others in the Myrtifloræ; Cucurbitaceæ in the Cucurbitales; Apocynaceæ and others in the Contortæ; Convolvulaceæ and others in the Tubifloræ; Basellaceæ in the Centrospermæ; Polygonaceæ in the Polygonales; and Euphorbiaceæ in the Geraniales.

1) ENGLER, A. — l. c. pp. XIV. XV. 2) ENGLER, A. – l. c. p. XV.

quently, groups of plants whose characteristics mostly occur in correlation are less changeable; while groups of plants whose characteristics usually occur independently are more changeable. Such families as the Orchidaceæ and Gramineæ belong to the former, while such as the Loganiaceæ and Myoporaceæ approach the latter class.

What he state in §§ 21 and 22 is, in brief, that on one hand he regards characteristics in linkage - relation as those denoting the serial orders of advancement and gives them a high systematic importance, but on the other hand he puts no value on the characteristics which occur independently and without regard to others. But, in this I cannot concur. In my opinion, we ought to take into consideration for classification all characters without being partial to any of them.

The perianth characters to which he refers in § 23[1] are the most important, as far as present systematic botany is concerned. But when we ask why they are so appreciated, no reason is forthcoming. There is nothing but convention to support the practice, as I have already explained.

In § 24 he says:—

> Mit Ausnahme sehr weniger Fälle liegt bei den Angiospermen klar zutage, daß die Formen mit Zwitterblüten phylogenetisch älter sind, als die sonst sich gleich verhaltenden mit eingeschlechtlichen Blüten. Diese Progression tritt unendlich oft ein und ist zur Gruppenbildung kaum zu verwerten.

But why is it that the characters of bisexual or unisexual flowers that show, as he expresses it, a serial advancement can not be appreciated as having high systematic value? This is, in my opinion, only because of insisting upon a static system. According to the dynamic view of a system, there can be no character that can not be so appreciated.

In §§ 25 and 26[2], he refers to many characters showing serial progression. He puts systematic value on some of these, but not on some others. But what is the reason of such partial treatment of characters? It is, as far as I can judge, merely because of an unquestioning acceptance of the present static system, which would of course at once be violated by the fair appreciation of all characters.

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1) ENGLER, A.—l. c. p. XVI. 2) ENGLER, A.—l. c. p. XVIII.

His statements[1] regarding such characters as ovules in § 29, fruits in § 30, seeds in § 31 and embryos in § 32, merely explain that the mutual relations of plants are different in agreement with different views.

He says in § 33:—

> Das eingehendere Studium der Gattungen größerer Pflanzenfamilien zeigt aber, daß diese häufig nach verschiedenen Richtungen hin vorgeschritten sind, daß ferner eine Gattung nach der einen Richtung vorschreiten, in anderen Merkmalen aber auf niederer Stufe verharren kann, daß endlich eine und dieselbe Progression zu wiederholten Malen in verschiedenen engeren Formenkreisen eintreten konnte. So entstehen verschiedene Kombinationen von Progressionen, welche die Anordnung oft erschweren.

This plainly shows that characteristics do not occur side by side and that the characters of species or genera do not consist of a single quality, but are a combination of many qualities. Should this statement be accepted, how can we insist upon the present static system? A system should be dynamic in order that it may show the natural relations of groups as they change with dynamic views. Further in § 34[2] he proceeds to say:—

> Wenn schon innerhalb einer Familie die Kombination der Progressionen und die Wiederholung derselben Progressionen dartun, daß die lineare Anordnung nur teilweise der Entwicklung eines Typus entspricht, da dessen Glieder an verschiedenen Stellen der Erde oder auch in demselben Gebiet nach verschiedenen Richtungen hin sich verändert haben, so ist dasselbe noch mehr innerhalb der Familienreihen der Fall. ....

Here he further extends what he stated in § 33, and says the same as to the relations between family and family.

In § 35, he says:—

> Man hat vermutet, daß der Ursprung derjenigen Dikotyledoneen, welche wir als Sympetalæ bezeichnen, nicht ein gemeinsamer sei, sondern daß sie sich an verschiedene Reihen der in diesem Buch als archichlamydeische Dikotyledoneen bezeichneten Gewächse anschließen. Diese Möglichkeit ist nicht zu bestreiten, da nicht wenige von den archichlamydeischen Familien einzelne Fälle von Sympetalie aufweisen. ....
> Es ist ferner zu berücksichtigen, daß wir zwar bei nicht wenigen Familien der Sympetalen noch einzelne Gattungen mit choripetaler Blütenhülle finden, daß diese sich aber im sonstigen Bau nicht an bekannte Familien der Archichlamydeae anschließen.... ....
> Dabei ist zu beachten, daß bei den meisten Sympetalen das Androeceum auf einen Kreis beschränkt ist und mit Rücksicht hierauf der Anschluß auch nur an einige wenige archichlamydeische Familien stattfinden könnte. Trotzdem hat sich ein solcher bisher nicht ermitteln lassen. Es ist deshalb wahrscheinlich, daß die Sympetalen

1) ENGLER, A. — l. c. pp. XIX. and XX. 2) ENGLER, A. — l. c. p. X I.

Typen darstellen, welche frühzeitig den Weg der Sympetalie eingeschlagen haben. Beachtung verdient auch der Umstand, daß bei dem größten Teil der Sympetalen, namentlich denen der letzen Reihen, die Samenanlagen durchweg mit nur einem Integument versehen sind, während bei den Archichlamydeae und den ersten Reihen der Sympetalen mit einem Integument versehene Samenanlagen seltener sind.

The above statement plainly shows that the relation of the Metachlamydeæ and Archichlamydeae is not static, but dynamic, as it changes in agreement with the different points of view. Consequently, to group series into the two classes, Archichlamydeæ and Metachlamydeæ, is quite right; only, the grouping is in that respect limited. But, in another respect, it is not so. Some of the Archichlamydeæ are nearer to some of the Metachlamydeæ than they are to others of the former class, in characters other than their choripetalous flowers. At the same time, some of the Metachlamydeæ are much nearer to some of the Archichlamydeæ than to some of the former class, in characters other than their gamopetalous nature. The Dichapetalaceæ[1] (Geraniales), Salvadoraceæ[2] (Sapindales), Fouquieriaceæ[3] (Parietales), Passifloraceæ[4] (Parietales), Achariaceæ[5] (Parietales), Oleaceæ[6] (Ebenales) and Rubiaceæ (Rubiales) may be mentioned as illustrating the above statements. The former families might properly be referred to the respective series (as given in parentheses) of the Archichlamydeæ according to one view; but, at the same time, they might be properly assignable to the respective series of the Metachlamydeæ; thus, the Salvadoraceæ to the Ebenales, the Fouquieriaceæ to the Tubifloræ; and the Passifloraceæ and Achariaceæ to the Cucurbitales. The Oleaceæ and Rubiaceæ might be properly referred to the respective series (as shown in the parentheses) of the Metachlamydeæ according to one view; but, at the same time, they are just as properly assignable to the Archichlamydeæ, e. g. the Oleaceæ to the Sapindales, and the Rubiaceæ to the Umbellifloræ. Which-ever may be the case, it is all right in that way of looking at it, but it is so only in that way. It certainly shows one of the natural relations. But the real natural relations are only seen by viewing their changeableness according to different criteria. That is to say natural relations are only demonstrative in what I call the dynamic system.

1) Nat. Pfl.-fam. III.—4, p. 347.
2) Nat. Pfl.-fam. IV.—2, p. 18.
3) l. c. Nacht. III. p. 228, Nacht. I. pp. 251 and 368.
4) l. c. III.—6, a, p. 78.
5) l. c. Nacht. I. p. 257.
6) l. c. IV.—2, p. 4.

To sum up what we have so far discussed, ENGLER's principles are those of the present static system, but the facts so far he has given them plainly show that the latter system is not qualified to express all the natural relations and that it should be a dynamic system that we ought to contemplate.

b. ENGLER'S EXPLANATION OF THE SYNOPSIS OF THE EMBRYOPHYTA SIPHONOGAMA[1].

Here let us consider at some length what we have discussed in the foregoing pages. ENGLER refers in p. 359 in his work to the calazogamy and states that it has no great systematic value, the only reason for this being that it does not come in correlation with other characters. In my judgement, however, various behaviors of pollen-tubes in different plants show some relations in that respect; this ought to be taken into the consideration in classification. It may prove to be inconvenient in the static system, but it does no harm in making a dynamic system. Then, he refers to VAN TIEGHEM's system[2], and puts no great importance on it. But I think that VAN TIEGHEM's system is right in that respect, although in that respect only. In a dynamic system it would be regarded as an important phase.

As to the Monocotyledons[3], he makes the following statement[4]: —

> ich habe gezeigt, dass unter den Monokotyledoneen zunächst Reihen existieren, bei denen in der Zahl der Blütenteile Unbeständigkeit herrscht, während andere vollständige oder reducierte pentacyklische Blüten besitzen. Auf der ersten Stufe stehen diejenigen Reihen, bei welchen noch vollkommen achlamydeische Blüten vorkommen. Es sind dies die *Pandanales*, *Helobiæ* und *Glumifloræ*.

Thus, he divides the Monocotyledons into two, according as whether the number of the floral elements is definite or indefinite. This is indeed one way of dividing, yet there are many others. Their natural relations will not be understood, till we divide and group them in several different ways. To learn

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1) ENGLER, A. — Erläuterungen zu der Übersicht über die Embryophyta siphonogama, in der Natürl. Pfl.-fam. Nacht. I. pp. 358-380, (1897).

2) RENDLE, A. B. — The Classification of Flowering Plants, I. p. 25, (1904).

3) Here I must call readers' attention to the fact that there are some indications of a second cotyledon in certain of the grasses, such as *Zizania*, *Avena*, etc. — JEFFREY, E. C.—The Anatomy of Woody Plants (Chicago, 1917) p. 377.

4) ENGLER, A. — Erläuterungen, l. c. p. 360.

the natural relations of the families in the Monocotyledons, the families must be observed according to the dynamic view and should be grouped according to every possible method. ENGLER'S system of the Monocotyledons shows but partial relations of consecutive families. He gives as groups showing inconstancy of floral elements the Pandanales, Helobiæ and Glumifloræ. As far as I can judge, the Pandanales and Helobiæ have indefinite numbers in floral elements, but the Glumifloræ have numbers various but constant to each of the genera of the series. The serial arrangement shown in his system, (e.g. the Pandanales, Helobiæ and then Glumifloræ), shows but partial relations in several different respects; it does not present to view the real relations in all directions. The first series is not only related to the next two, but also to many other series.

Further he says[1] :—

> Dass unter diesen die **Pandanales** wegen vorherrschender Nacktblütigkeit und wegen großer Unbestimmtheit in der Zahl der bisweilen auch noch spiralig angeordneten Staubblätter die niederste Stufe einnehmen, ist sicher. Ob nun die *Glumifloræ* oder die *Helobiæ* folgen sollen, ist schwer zu entscheiden.

It is true, indeed, that the Pandanales seem to have such a definite position, when regard is paid to their naked flowers. But in other respect, the series is somewhat connected with the Principes[2], as can be seen in the analogy between the Pandanaceæ and the Palmæ (*Phytelephas* and *Nipa*). It bears also some resemblance to the Araceæ[3] of the Spathifloræ. Moreover, it is more or less allied to the Synanthæ, when the Cyclanthaceæ[4] in their floral structure approach *Freycinetia* of the Pandanaceæ (II.–3, p. 98). The real relations of the Pandanales should, therefore, be observed according to the dynamic view. In the above quotations, he refers to the difficulty of determining which of the Glumifloræ and Helobiæ should take precedence. But, in my opinion, such a question is without significance. One series will precede another in one respect, but will follow it in another respect. Thus only can we understand their natural relations as manifested in all views.

As to the Helobiæ[5], he says as follows :—

1) ENGLER, A. — Erläuterungen, l. c. p. 360.
2) Nat. Pfl.-fam. II.—1, p. 190, and II.—3, p. 25.
3) Nat. Pfl.-fam. II.—3, p. 98. 4) Nat. Pfl.-fam. II.—3, p. 98.
5) ENGLER, A. — Erläuterungen, l. c. p. 360.

> Bei den Familien der **Helobiæ** sehen wir die Blüten alle möglichen Stufen von der Achlamydie bis zur Heterochlamydie, von der Hypogynie bis zur Epigynie, von unbestimmter Zahl der Staubblätter und Carpelle bis zu begrenzter durchmachen, und wegen dieser noch großen Unbeständigkeit lasse ich diese Reihe den *Glumifloræ* vorangehen. Die Reihe gliedert sich in 3 Unterreihen, in die *Potamogetonineæ* mit den *Potamogetonaceæ, Najadaceæ, Aponogetonaceæ* und *Juncadinaceæ*, in die *Alismineæ* und *Butomineæ*. Die Trennung der letzteren halte ich wegen der bei den *Butomaceæ* und *Hydrocharitaceæ* vorkommenden Stellung der Sa. auf den Wandflächen der Carpelle für notwendig.

ENGLER's Helobiæ referred to in the above quotation are, in my estimation, a collection of heterogeneous families bounded artificially by partial relations, (that is to say, bounded by this one in one case of these two families, but by that one in another case of those two families). The natural relations of the Helobiæ to the others are accordingly, even in the present state of our knowledge, very extensive. In the first place, the series is partly related to the Liliifloræ and partly to the Farinosæ; the connection with the former series is manifested in the Hydrocharitaceæ which bear some resemblance to the Iridaceæ and Amaryllidaceæ in the inferior ovary, while the relation to the latter series is exhibited also in the Hydrocharitaceæ which have the same kind of ovary in common with the Bromeliaceæ and share the axillary flowers, perianth and parietal placentas with the Mayacaceæ[1] (both of the latter series). In the second place, it somewhat approaches the Spathifloræ, as can be seen in the relation between *Zostera* and the Araceæ[2]. In the third place, though it is placed far apart from the Ranales in ENGLER's system, its alliance with the latter series is incontestable, as we can see a striking resemblance between the flowers of the Alismataceæ and those of the Ranunculaceæ[3], in the numerous stamens, apocarpous gynæcea, and in the habit. Further, some resemblance, although very slight, is found in the Triuridales[4], in the numerous free carpels. It is also related to the Microspermæ[5], as the Hydrocharitaceæ are compared with the Burmanniaceæ and Orchidaceæ by BENTHAM-HOOKER, on the ground that these families have in common the

1) Nat. Pfl.-fam. II.—4, p. 18.
2) Nat. Pfl.-fam. II.—1, p. 201.
3) Nat. Pfl.-fam. II.—1, p. 229; LOTZY, J. P. — Vorträge über Botanische Stammesgeschichte, III.—1, p. 625.
4) Nat. Pfl.-fam. II.—1, p. 237.
5) BENTHAM et HOOKER, Genera Plantarum III. pp. 449 and 456.

inferior ovary, parietal placenta and exalbuminate seeds. Consequnetly, some of the Helobiæ are certainly connected with the Liliifloræ, some with the Farinosæ, some with the Spathifloræ, some with the Ranales, some with the Triuridales, and some with the Microspermæ. The natural position of the series is, therefore, not necessarily settled as between the Pandanales and the Glumifloræ. It should be placed here at one time, but there at another.

Next to the Helobiæ, ENGLER refers to the Triuridales[1] in his syllabus. But, it is rather questionable whether the series belongs to the Monocotyledones or the Dicolytedones. On one hand, as has been pointed out before, it is somewhat related to the Helobiæ, but on the other hand, to the Microspermæ, as can be seen in a comparison of the Triuridaceæ with the Orchidaceæ.

Then, he treats of the Glumifloræ[2]. But, decidedly, this series also is not to be definitely placed between the Helobiæ and Principes in the true natural system. It has some connection with the Liliifloræ through the Juncaceæ[3] in its vegetative organs[4] and in its external form; and also with the Farinosæ, as can be seen in the external relation between the Cyperaceæ and the Eriocaulaceæ[5]. Its natural position should be changed according to different views.

The next series[6] placed by ENGLER are the following three:—Principes, Synanthæ and Spathifloræ. They by no means stand in a serial relation, but rather in a close inter-relation between themselves and also in relation with other series. The first series is somewhat allied to the Pandanales, as we have above stated. To some extent they approach the Synanthæ, as the Cyclanthaceæ of the latter series have an incontestable similarity to the Palmæ[7] in the vegetative organs. The second series is related to the Pandanales and Principes, as we have seen before. At the same time, the resemblance in the vegetative organs of the Cyclanthaceæ and those of the Araceæ[8] indicates that the Synanthæ and Spathifloræ are related. The relations of the latter series to the Pandanales, to the Synanthæ and to the Helobiæ have been already

1) ENGLER, A.—Syllabus, l. c. p. 123; Nat. Pfl.-fam. II.—1, p. 235.
2) ENGLER, A.—Erläuterungen, l. c. p. 360.
3) Nat. Pfl.-fam. II.—2, p. 104.
4) JEFFREY, E. C.—l. c. p. 413.
5) Nat. Pfl.-fam. II.—2, p. 104.
6) ENGLER, A.—Erläuterungen, l. c. p. 360.
7) Nat. Pfl.-fam. II.—3, p. 25.
8) Nat. Pfl.-fam. l. c. II.—3, p. 25 and JEFFREY, E.C.—l.c. p. 413.

referred to. Their positions, therefore, cannot be definitely settled.

As to the Farinosæ and Liliifloræ, ENGLER says[1] that the two series should be placed at a lower stage than the Scitamineæ and Microspermæ. He is right in that, but only in so far as their zygomorphy or some other characters are considered. But, some of the Microspermæ approach rather towards the Helobiæ; certain of the Scitamineæ resemble in some measure the Farinosæ. When we look at the series in a light different from that in which ENGLER has regarded them, their natural positions must be different from those stated by ENGLER.

The natural relations of the Farinosæ to other series are not so simple as to warrant their being placed next to the Liliifloræ. In reality they are so complicated that they ought to be placed in dynamic positions changeable according to our ways of looking at them. The alliance of this series with the Helobiæ and Glumifloræ has already been referred to. It remains to compare them with other series. In the first place, the series bears some resemblance to the Liliifloræ, as the Flagellariaceæ[2] agree with Juncaceæ in having 5-whorled flowers with homochlamydeous perianth; as the Bromeliaceæ[3] approach the Amaryllidaceæ in their vegetative organs; and, as the Cyanastraceæ[4] come close to the Hæmodoraceæ. In the second place, the Farinosæ are also related to the Scitamineæ, as can be seen in the analogous features of the Bromeliaceæ[5] and Scitaminaceæ, which features are shown in the perianths separated in the outer calyx-like, and the inner corolla-like, whorls.

The natural relations of the Liliifloræ to other series, too, are not such as to justify us in giving the series a fixed position. The resemblance which it bears to the Glumifloræ, Farinosæ, Helobiæ and Spathifloræ, has already been discussed. Some analogous points between the Amaryllidaceæ and Burmanniaceæ point out the relationship of the Liliifloræ and Microspermæ[6].

Next in ENGLER's system come the Scitamineæ[7]. The relations of this

1) ENGLER, A. — Erläuterungen, l. c. p. 361.
2) Nat. Pfl.-fam. II.—4, p. 1.
3) Nat. Pfl.-fam. II.—4, p. 40.
4) Nat. Pfl.-fam. Nacht. III. p. 43.
5) Nat. Pfl.-fam. II.—4, p. 40.
6) Nat. Pfl.-fam. II.—6, p. 46.
7) ENGLER, A. — Erläuterungen, l. c. p. 361.

series to others again show the impossibility of fixing its position. Its relation to the Farinosæ has been referred to before. It is also allied to the Microspermæ, as analogous facts between the two series are shown in the imperfect staminal whorl in the all families of the Scitamineæ and the Orchidaceæ, and in the floral diagram of *Musa* and that of *Arundina pentandra* Reichb. f[1].

Finally, he refers to the Microspermæ[2]. That this series is related to the Liliifloræ, Farinosæ, Triuridales, Helobiæ, and Scitamineæ has already been stated. Consequently, it is a series which should change its position according to different views. I repeat, in this case and in all cases, that their (species, genera, etc.) positions vary with the views taken of them. Change as they do, yet they do not change their positions at random, but do so according to the universal law, which I would call the law of natural relation.

Engler then makes the following statement[3] as to the relation of the series above referred to :—

> Aus diesen hier nur kurz behandelten Beziehungen der Reihen und Familien der Monokotyledoneen ergiebt sich, dass die Anfänge derselben weit zurück liegen, dass wohl diagrammatisch einzelne Reihen von anderen abgeleitet werden können, im übrigen aber noch Grundverschiedenheiten existieren, welche die einzelnen Reihen und auch die einzelnen Familien charakterisieren.

The same statement can be seen in the diagram given by him in p. 373. In my opinion, however, the series we have thus far studied, as we have stated before, are all closely inter-related. Indeed, we are convinced of the existence of a basic unity, instead of the basic difference (Grundverschiedenheit) mentioned by Engler in the above quotations. Their inter-relation and basic unity can be better understood than otherwise, if we accept the participation theory which we have alluded to before.

Further, Engler proceeds to explain his system of the Dicotyledones. Here he refers to the difference between Eichler's system and his own, and remarks[4] :—

> Eine der wesentlichsten Änderungen im Systeme der Dikotyledoneen ist zunächst

1) Nat. Pfl.-fam. II.—6, p. 75.
2) Engler, A. — Erläuterungen, l. c. p. 361.
3) Engler, A. — Erläuterungen, l. c. p. 361.
4) Engler, A. — Erläuterungen, l. c. p. 362.

die Auflösung der Reihe der *Amentaceæ* und die Einschaltung der von Eichler anhangsweise als *Hysterophyta* vereinigten Familien an verschiedenen Stellen des Systemes. Dass die *Amentaceæ*, welche bei Eichler die *Cupuliferæ*, die *Juglandaceæ*, *Myricaceæ*, *Salicaceæ*, *Casuarinaceæ* umfassen, nicht einen natürlichen Verwandtschaftskreis darstellen, hat sich bei näherer Untersuchung der Sa. und der Befruchtungsvorgänge in neuerer Zeit immer mehr herausgestellt, dass die Aufstellung der *Hysterophyta* nur ein Notbehelf war, war bei der längst bekannten Verschiedenheit ihrer Gynäceen von vornherein klar.

The series, Amentaceæ, of EICHLER, is a group, the members of which all agree in having male catkin. Though we may break up this group and make of it several groups, as ENGLER does, this is right only when the series is looked at in the way described by ENGLER. Another alteration made by ENGLER on the same occasion, is right only when viewed in the same light as that in which he looks at it. In my judgement, on comparing the systems of the great authors, such as BENTHAM- HOOKER, EICHLER, and ENGLER, his groups appears to be not the most natural but rather the most convenient.

Then he proceeds to say[1] :—

Die beiden Unterklassen der Dikotyledoneen, *Archichlamydeæ* und *Metachlamydeæ* oder *Sympetalæ* sind beibehalten worden, obwohl eine scharfe Grenze zwischen denselben nicht existiert.

But, in my estimation, it is not enough in this case to say that there is but a faint line of division between the two subclasses, but it should be added that there is close inter-relation between the series of one subclass and those of the other. The inter-relation is closely manifested between the Cucurbitales and the Parietales; between the Rubiales on one side and the Parietales, Rosales and Umbellifloræ on the other; between the Tubifloræ on one side and the Malvales, Parietales and Rhœadales on the other; between the Contortæ and the Sapindales; between the Ebenales on one hand and the Ranales and Parietales on the other; between the Primulales and the Sapindales; and finally between the Ericales on one side and the Parietales and Sapindales on the other. We shall explain this matter in detail as we go on in our discussion of series after series. Here we see that to divide the Dicotyledones into the Archichlamydeæ and Metachlamydeæ is only right according to the view upon which we dwell. But when viewed from another standpoint, it is not right. To

1) ENGLER, A. — Erläuterungen, l. c. p. 362.

understand the natural relations between the different series of the Dicotyledones, each of the latter should be viewed in every possibly different light, and divided and grouped according to every possible means. This is what I intend to show in my dynamic system.

As to the criteria for classifying the Archiclamydeæ, ENGLER says as follows :[1]—

> Für die Anordnung der Reihen innerhalb der *Archichlamydeæ* sind vorzugsweise die Ausbildung der Blütenhüllen, der Blütenachse und die Anordnung der Blütenphyllome maßgebend;........

In a word, his system is one that shows here a partial relation between family A and family B; and there another partial relation between family B and family D, mostly according to the criterion of flowers. Now, we shall look at the matter series by series.

Beginning with the Verticillatæ, ENGLER places the series[2] at the commencement of the Dicotyledones. It is closely allied to the Gnetales, as can be seen in the agreement in the course of the vascular bundles in *Ephedra* and *Casuarina*[3]. The resemblance is still greater in the structure of stomata and in the development of embryo. On the other hand, if chalazogamy which is found in the Casuarinaceæ, Juglandaceæ, Betulaceæ and certain Urticaceæ[4] is taken into consideration, the Verticillatæ seem to have some alliance with the Juglandales and Fagales. Furthermore, the Verticillatæ seem to bear some resemblance to the Fagales and in all probability to the Ericaceæ[5]. Its natural position, therefore, is not a settled one, but should be a dynamic one.

As to the Piperales, our knowledge is not yet sufficient to decide the relations between this series and others.

Next, ENGLER places the Salicales[6] between the Piperales and the Garryales; but the view is, as far as my knowledge extends, entirely one-sided. A close relation of this series and the Parietales is not to be disputed, when we see, on comparing the Salicaceæ[7] and Tamaricaceæ, their

1) ENGLER, A. — Erläuterungen, l. c. p. 362.
2) ENGLER, A. — Erläuterungen, l. c. p. 362.
3) Nat. Pfl.-fam. III.—1, p. 18, and Nacht. III. p. 92.
4) JEFFREY E. C. — The Anatomy of Woody Plants, (Chicago, 1917) p. 376.
5) JEFFREY, E. C. — l. c. p. 385.
6) ENGLER, A. — Erläuterungen, l. c. p. 362.
7) Nat. Pfl.-fam. III.—1, p. 35.

agreement in the gynæceum, placentas, ovules, fruits and seeds. Moreover, their relation, when coupled with the parallelism in their anatomical character, e.g. in the perforation of vessels[1], becomes still more complete. Some resemblance to the Batidales is indicated by the dimerous gynæceum in both Salicaceæ and Batidaceæ[2]. Further, the Salicales are regarded by some authors as comparable with the Myricales and with the Juglandales[3]. Now, take fruits and seeds as the criterion for comparison, then the Salicales should be taken far away from their present position and put close to the Parietales. Next, take into consideration for classification the absence of perianth in the Salicales, and you will find the latter series quite right in its present place near the Juglandales, Fagales[4], Batidales or Myricales.

Then, follow the Garryales[5] after ENGLER's system. As to this series, our knowledge is too incomplete for an understanding of its relation to other series.

Next, come the Myricales[6]. They are comparable with the Fagales, Salicales and Juglandales in this point or that[7].

Here, ENGLER places the Balanopsidales[8]. This series is somewhat allied to the Geraniales, as is indicated by the agreement in the structure of the ovules of the Balanopsidaceæ and Euphorbiaceæ[9]. Consequently, its natural position is movable from this place to that, from proximity to the Myricaceæ far away to near the Euphorbiaceæ.

Then, follow the Leitneriales. It is difficult to deny that they are related to the Rosales, when we consider the resemblance of the Leitneriaceæ[10] and Hamamelidaceæ in the resin-ducts in the medullary-sheath.

Here, ENGLER places the Juglandales. Their relation to the Myricales, Salicales and Verticillatæ has already been stated. They are also allied to some extent to the Fagales, and Urticales[11]. But, a greater resemblance is to be found in the Julianiales[12]. The alternate, exstipulate, imparipinnate leaves and the resinifer-

1) Nat. Pfl.-fam. III—6, p. 291.
2) Nat. Pfl.-fam. Nacht. III. p. 105.
3) WETTSTEIN, R. R. — Handb. Syst. Bot. p. 499, (1911).
4) JEFFREY, E. C. — l. c. p. 384.
5) ENGLER, A. — Syllabus, l. c. p. 159.
6) ENGLER, A. — Erläuterungen, l. c. p. 362.
7) WETTSTEIN, R. R. — l. c. pp. 496–499.
8) ENGLER, A. — Erläuterungen, l. c. p. 363.
9) BENTH-HOOKER, Gen. Pl. III. 341.
10) ENGLER, A. — Erläuterungen, l. c. p. 363.
11) JEFFREY, E. C. — l. c. 376.
12) HEMSLEY, W. B. — On the Julianiaceæ: A New Natural Order of Plants, in Phil. Trans. Roy. Soc. Lond. Series B, CXCIX. pp. 169–197, Plates 18–24.

ous character, the solitary exalbuminous seeds, the dissimilar male and female flowers, especially the latter with reduced envelopes, the broad stigmatic lobes of the styles and the single coated ovules, in both Juglandaceæ and Julianiaceæ, — all these point to their close relationship. In no less degree than to the Julianiales, the present series bears likeness to the Sapindales, as can be seen in the agreement of the Juglandaceæ and Anacardiaceæ[1], in the alternate, exstipulate, imparipinnate leaves, in the resiniferous character, and in the solitary exalbuminous seeds. The natural position of the Juglandales should, therefore, be changed from this place in ENGLER's system, far away to a place close to the Anacardiaceæ, according to the law of natural relationship.

Here ENGLER places the Batidales[2] in his syllabus. Their relation to the Salicales has been discussed above. Some alliance may be noticed between the Batidales and the Centrospermæ, in a comparison of the Batidaceæ with Chenopodiaceæ[3].

Next, follow the Julianiales[4] in his syllabus. Their close relationship to the Juglandales has been referred to before. In no less degree is affinity shown towards the Sapindales. The Julianiaceæ and Anacardiaceæ[5] representing respectively the two series agree in the alternate exstipulate, imparipinnate leaves, in the unisexual flowers with reduced envelopes, in the solitary exalbuminous seeds, in the singular funicular development, in the embryo, and in the anatomical characters. In other respects, but in the same degree, they are related to the Fagales[6] in the male inflorescence, in the male flowers and pollens, in the several female flowers in a closed involucre, in the exalbuminous seeds and in the cotyledons epigæous in germination. A place between the Fagales and Juglandales or next to the Sapindales would be equally suitable and natural for the Julianiales.

Then, comes the Fagales.[7] The resemblance which this series bears to the Verticillatæ, Myricales, Salicales, Juglandales and Julianiales has been indicated above. Furthermore, the Fagales have some affinity to the Urticales,

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1) HEMSLEY, W. B.—On the Julianiaceæ, in Phil. Trans. l.c. pp. 190–193.
2) ENGLER, A. — Syllabus, l. c. p. 161.
3) Nat. Pfl.-fam. III.—1, a, p. 120.
4) ENGLER, A. — Syllabus, l. c. p. 161.
5) HEMSLEY, W. B. — l. c. pp. 190–193.
6) HEMSLEY, W. B. — l. c.
7) ENGLER, A. — Erläuterungen, l. c. p. 363.

in so far as the chalazogamy itself or its transition to the porogamy found in the two series is concerned[1]; and also in all probability to the Ericaceæ in the anatomical characters[2]. Its position should, therefore, be shifted from one place to another, according to each one of its natural relations.

Next, follows the Urticales[3]. The affinity of this series to the Verticillatæ, Juglandales and Fagales has been pointed out before.

Here also ENGLER puts the Proteales; as to this series, our knowledge is as yet very limited; the only relation that is thus far known to us is to the Santalales, as the Proteaceæ and Loranthaceæ[4] show some agreement in the perianth-lobes and in the andrœceum.

Next, come the Santalales[5] according to ENGLER'S system. He places this series here in a fixed position, but its rather complicated relation to other series clearly indicates the mutability of its natural position according to the view taken of it. Thus, the affinity of this series to the Proteales, as has been mentioned, is clear. Then, the resemblance borne by the Santalales to the Coniferæ or to the Gnetaceæ is so very striking that it not only presents external analogy, but also suggests many morphological relations[6]. Moreover, to some extent it approaches the Sapindales, as the Olacaceæ[7] and Icacinaceæ show a perfect similarity in their fruits and external features. Further, it bears also some resemblance to the Rosales, as can be seen in the Grubbiaceæ[8] and Hamamelidaceæ which show agreement in their wood-anatomy. Certain of the Santalales (Balanophoraceæ)[9] are, by some authors, compared with the Myrtifloræ from the view that *Cynomorium* (Balanoph.) and *Hippuris* (Halorrhag.) show some resemblance in their bisexual flowers. Finally, the relationship of the Santalales and Rhamnales is recognizable, when we compare the Loranthaceæ and Vitaceæ, taking the calyculus of the Loranthaceæ or *Viscum* for a reduced calyx. Thus, the Santalales is related to the Proteales, Coniferæ, Sapindales, Rosales, Myrtifloræ and finally to the Rhamnales. Its natural position is, therefore, changeable from one place to another, so that it should

1) WETTSTEIN, R. R. — l. c. p. 501.
2) JEFFREY, E. C. — l. c. p. 385.
3) ENGLER, A. — Erläuterungen, l. c. p. 363.
4) Nat. Pfl.-fam. III.—1, p. 176.
5) ENGLER, A. — Erläuterungen, l. c. p. 363.
6) Nat. Pfl.-fam. III.—1, p. 211.
7) Nat. Pfl.-fam. III.—1, p. 233.
8) Nat. Pfl.-fam. III.—1, p. 229.
9) Nat. Pfl.-fam. III.—1, p. 249.

be placed close to the Proteales at one time, but brought near the Rhamnales at another.

Then, ENGLER refers to the Aristolochiales[1]. This series must certainly be directly related to the Metachlamydeæ when the prominence at the apex of the inferior ovary of *Aristolochia* is, as I should think proper, taken for a reduced calyx and the gamophyllous perianth is, as a consequence, regarded as a corolla. Further, it is related to the Sarraceniales, as can be seen from the agreement in the Aristolochiaceæ and Nepenthaceæ[2] in the perianth, in the extrorse anthers, in the many-seeded carpels and in the lobes of the stigmata. Moreover, the resemblance of this series to Ranales[3]* is undeniable, as the extrorse anthers, placentas, seeds, and secretory-cells are found in some families of both series. The natural position of the Aristolochiales can not be fixed here. It should be in some place among the Metachlamydeæ at one time, but at another time among the Archichlamydeæ near to the Ranales or the Sarraceniales.

Then follow the Polygonales[4]. As to this series, we know but little about its relation to others. As far as we are aware, it is related to the Centrospermæ, as some analogous points are found in the Polygonaceæ and Amarantaceæ[5].

After explaining the portions of his system thus far referred to, ENGLER state[6] :—

> Wenn oben gesagt wurde, dass einzelne Reihen morphologische weiter vorgeschritten seien, als andere, dass andererseits gewisse Reihen, wie z. B. die *Fagales* und *Urticales* auf der gleichen morphologischen Stufe stehen, so ist dennoch eine jede der genannten Reihen als eine selbständige Pflanzengruppe anzusehen, welche in keiner Weise von einer der anderen abgeleitet werden kann. Ebenso wenig ist irgend welcher Grund zu der Annahme vorhanden, dass eine dieser Reihen der Ausgangspunkt für eine der folgenden Reihen gewesen ist. Finden sich in den Reihen Formen, welche einen näheren Anschluss

1) ENGLER, A. — Erläuterungen, l. c. p. 363. 2) Nat. Pfl.-fam. III.—2, p. 259.
3) WETTSTEIN, R. R. — l. c. p. 555. 4) ENGLER, A. — Erläuterungen, l. c. p. 364.
5) Nat. Pfl.-fam. III.—1, a, p. 8. 6) ENGLER, A. — Erläuterungen, l. c. p. 364.

* The relation also exists between the Aristolochiaceæ and Nymphaeaceæ, as can be seen in the serum-reactions in the both families. Cf. MEZ, C. and LANGE, L. — Serodiagnostische Untersuchungen über die Verwandtschaft innerhalbe der Pflanzengruppe der Ranales (Beitr. z. Biol. d. Pflanzen, 12. pp. 218—222).

an Formen einer anderen Reihe gestatten, dann sind dieselben aus der ersteren zu entfernen und an die andere anzuschließen.

In my opinion, however, such is not the case. As I have discussed series after series, the several groups bear a close or loose relation to other groups, some of which lie near the group under consideration and some far from it, even judging from our present limited knowledge. Some species assignable to a series in one respect are just as clearly referable to another series in another respect. It is absolutely impossible to make up more natural groups, by taking one form from its old place to a new one. Natural relations should, in any case, appear in the dynamic view.

Now, we should examine the Polypetalous groups. Let us begin with the Centrospermæ. This series is related to the Batidales, Polygonales, Urticales, and Santalales, as has been discussed before. It is also allied to the Parietales, as is indicated by the agreement in the position of stamens in the Portulacaceæ and Loasaceæ[1]. On the other hand, the resemblance is to be found in this series and the Rhœadales, the floral structure being somewhat similar in the Phytolaccaceæ and Tovariaceæ[2] (BENTH.-HOOKER). Further, it bears some relation to the Geraniales, in the matter of the incontestable resemblance in the Caryophyllaceæ-Silenoideæ and the Linaceæ[3]. Moreover, a striking affinity of the Centrospermæ to the Opuntiales is suggested in *Mesembrianthemum* of the Aizoaceæ and in *Opuntia* of the Cactaceæ in the floral structure[4]. The Centrospermæ are, therefore, related to the Batidales, Polygonales, Urticales, Santalales, Parietales, Ranales, Rhœadales, and Geraniales, in this point or that. Their natural position should be a very dynamic one.

Next come the Ranales[5]. As this series implies many different things, its relations extend to many other series. Some families of the Ranales are closely allied to the Monocotyledones and some are, if not very evidently, even to the Metachlamydeæ. The relations of the Ranales to the Urticales, Helobiæ and Aristolochiales, we have treated above. Their affinity to the Ebenales can not

1) Nat. Pfl.-fam. III.—6, a, p. 106.
2) Nat. Pfl.-fam. III.—2, p. 207.
3) Nat. Pfl.-fam. III.—4, p. 30.
4) WETTSTEIN, R. R. — l. c. p. 533.
5) ENGLER, A. — Erläuterungen, l. c. p, 364.

be entirely denied, as the Ebenaceæ in the rimose albumen and trimerous flowers of *Maba* are connected with the Anonaceæ[1]. Moreover, the resemblance of the Magnoliaceæ[2] and Coniferæ in their wood-anatomy seems to me to suggest the existence of some relation between the Ranales and Coniferæ. Further, the Ranales show some affinity to the Sapindales, as can be seen from the agreement of the Menispermaceæ and Sabiaceæ[3] in the exalbuminous seeds, curved embryo, reniformed fruits, and nearly apocarpous gyæceum. On the other hand, their alliance to the Parietales is very close and intricate; the Ranunculaceæ are connected with the Dilleniaceæ[4] in floral structure and also with the Ochnaceæ[5]; the Magnoliaceæ, with the Winteranaceæ[6] in the inconstant number and spiral arrangement of the perianth-segments, in the oil-cells in the cortex, medulla and leaves, and in the bordered pits in the xylem-parenchyma; the Anonaceæ, with the Ancistorocladaceæ;[7] and finally the Myristicaceæ, wtih the Winteranaceæ[8] in the oil-cells and connate stamens, and also with the Ancistrocladaceæ. Furthermore, the Ranales bear some relation to the Rhœadales, as we shall see in the conformity of the Nymphæaceæ[9] and Papaveraceæ in the laticiferous vessels, in the vascular bundles in the medulla, and in the attachment of the seeds to the wall of the ovary; in that of the Berberidaceæ[10] and Papaveraceæ in the di- or tri-merous structure of the flowers and in the seeds; and finally, in that of the Anonaceæ[11] and Papaveraceæ in the structure of the ovary. Moreover, the connection between the Ranales and the Sarraceniales is to be found in the Nymphæaceæ and Sarraceniaceæ[12], both families showing perfect agreement in the position of leaves of the stem, in the one-flowered scape, in the spiral arrangement of the sepals, and in the numerous stamens. In no less degree, the present series manifests its relationship to the Rosales, for the agreement of the Ranunculaceæ and Rosaceæ in their floral structure is undeniable; the same relation can be seen between the Calycanthaceæ and the latter family[13].

1) Nat. Pfl.-fam. IV.—1, p. 157.
2) Wettstein, R. R.—l. c. p. 548.
3) Nat. Pfl.-fam. III.—5, p. 369.
4) Nat. Pfl.-fam. III.—6, p. 108.
5) Wettstein, R. R.—l. c. p. 596.
6) Nat. Pfl.-fam. III.—6, p. 316.
7) Nat. Pfl.-fam. III.—6, p. 276.
8) Nat. Pfl.-fam. III.—6, p. 316.
9) Nat. Pfl.-fam. III.—2, p. 3.
10) Nat. Pfl.-fam. III.—2, p. 74.
11) Nat. Pfl.-fam. III.—2, p. 27.
12) Nat. Pfl.-fam. III.—2, p. 251.
13) Nat. Pfl.-fam. III.—3, p. 10.

Moreover the Lauraceæ[1] of the Ranales show a close affinity to the Thymelæaceæ in the thoroughly circular arrangement of the floral elements in the perigynous insertion of the stamens, and in the symcarpous gynæceum.

Next, come the Rhœadales. Of this series, ENGLER speaks as follows[2] :—

> Schon lange hat man die **Rhoeadales** gern an die *Ranales* angeschlossen, und dies hat auch seine Berechtigung, da die *Papaveraceæ* wegen ihrer meist zahlreichen Staubblätter und ihres bisweilen noch aus mehreren, wenn auch vereinten Carpellen gebildeten Gynäceums Analogien mit den *Nymphæaceæ* zeigen, bei welchen ein syncarpes Gynäceum zu Stande kommt. .... Sehr große Übereinstimmung zeigen mit dieser Reihe die *Parietales*, von denen namentlich die *Dilleniaceæ* an die *Ranales* anklingen, während die *Flacourtiaceæ* zu den *Capparidaceæ* Beziehungen ergeben.

But, in my opinion, the real relation of the Rhœadales to other series extends far more widely. Its affinity to the Centrospermæ and to the Ranales has been discussed. Further, the Rhœadales bear some resemblance to the Geraniales, the likeness being shown in the Kœberliniaceæ[3] and Rutaceæ in the presence of oil-glands and in the other anatomical characters (BENTH.-HOOKER). The same is true of the former family and the Simarubaceæ (BENTH.-HOOKER). On the other hand, a very close and rather intricate relation is to be found between some families of the Rhœadales and those of the Parietales, namely :—between the Papaveraceæ and the Loasaceæ[4] (DE CANDOLLE) ; between the Capparidaceæ and the Flacourtiaceæ[5] or the Erythrospermeæ of the latter family ; between the Moringaceæ[6] and the Violaceæ (HOOKER) ; between the Kœberliniaceæ[7] and the Bixaceæ in their deciduous sepals ; and between the former family and some others of the Parietales in the placenta with numerous poly-seriate seeds (BENTH.-HOOKER). Moreover, some connection between the Rhœadales and the Sarraceniales is indicated in the Papaveraceæ and Sarraceniaceæ[8]. Furthermore, the agreement of the Kœberliniaceæ[9] and Saxifragaceæ (in the placenta with numerous poly-seriate seeds), and that of the Moringaceæ[10] and Leguminosæ show some relation between the Rhœadales and the Rosales (BENTHAM). And finally, this

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1) Nat. Pfl.-fam. III.—2, p. 111.
2) ENGLER, A. — Erläuterungen, l. c. p. 365.
3) Nat. Pfl.-fam. III.—6, p. 321.
4) Nat. Pfl.-fam. III.—6, a, p. 106.
5) l. c. III.—6, a, p. 10.
6) l. c. III.—2, p. 243.
7) l. c. III.—6, p. 321.
8) l. c. III.—2, p. 251.
9) Nat. Pfl.-fam. III.—6, p. 321.
10) l. c. III.—2, p. 243.

presents some analogy with the Tubifloræ, as is shown in the Moringaceæ[1] and Bignoniaceæ (DALZELL). Thus, the relation of the series is found to be not only with the Ranales and the Parietales, but also with the several other series, from the Centrospermæ all the way up to the Tubifloræ. The natural position of the series is, therefore, necessarily dynamic.

Then, come the Sarraceniales[2], to which ENGLER refers as follows:—

> Eine Parallelreihe der *Rhœadales* habe ich in den **Sarraceniales** geschaffen. Die *Sarraceniaceæ* hat man in enge Verbindung mit den *Nymphæaceæ* und die *Papaveraceæ* bringen wollen, und es ist auch ganz gewiss, dass diese Familien in der Anordnung der Blütenteile mancherlei Übereinstimmung zeigen. Der spirocyklische Bau der Blüten von *Sarracenia* erinnert stark an *Nymphæa*; aber die Placentation der *Sarraceniaceæ* ist verschieden von der der *Nymphæaceæ* und der *Papaveraceæ*; die vorherrschend centralwinkelständigen Placenten der *Sarraceniales* sind es auch, welche diese Reihe von den *Rhœadales* unterscheiden.

But, the real relations of this series to other series are manifold. Its relations to the Ranales, Rhœadales and Aristolochiales have already been discussed. Moreover, it resembles the Rosales, as will be seen in the Droseraceæ[3] and Saxifragaceæ (especially in *Parnassia*) both of which agree in the perigynous insertion and in the ovary in the transitional stage. The connection of the Sarraceniales with the Parietales is to be found in the Droseraceæ[4] and Cistaceæ or Violaceæ in the hypogynous insertion and in the real parietal placenta. Thus, the relations of this series to others are rather extensive. Its position in the natural system should, therefore, be dynamic.

Here, next to the Sarraceniales, ENGLER puts the Rosales[5], which in its relations to other series is rather perplexing. Its relations to the Santalales Leitneriales, Centrospermæ, Ranales, Rhœadales, and Sarraceniales have been discussed one after another in course. It remains to compare it with other series. Its resemblance to the Parietales is most clearly manifested in the agreement of the Crassulaceæ[6] and Elatinaceæ[7] in their isomerous flowers (BRONGNIART, A. BRAUN); in the agreement of the Saxifragaceæ and the Eucryphiaceæ[8]; of the former family and Begoniaceæ[9] in the somewhat

1) Nat. Pfl.-fam. III.—2, p. 243.
2) ENGLER, A. — Erläuterungen, l. c. p. 365.
3) Nat. Pfl.-fam. III.—2, p. 267.
4) Nat. Pfl.-fam. III.—2, p. 267.
5) ENGLER, A. — Erläuterungen, l. c. p. 365.
6) Nat. Pfl.-fam. III.—2, a, p. 28.
7) l. c. III.—6, p. 280.
8) l. c. III.—6, p. 131.
9) l. c. III.—6, a, p. 131.

perigynous insertion, in the parietal placentas, in the smallness of the seeds, in the dehiscence of the fruit and in the shape of the leaves; of the Cunoniaceæ and the Quiinaceæ[1], in external features and in the densely hairy seeds; of the Hamamelidaceæ and Dipterocarpaceæ[2] in the presence of a ring of secretory-canals in the medulla-crown; and finally, of the Rosaceæ and the Eucryphiaceæ[3]. Moreover, some affinity between the Rosales and the Geraniales is to be found in a few analogous features of the Pittosporaceæ[4] of the former series on the one side, and of the Vochysiaceæ, Polygalaceæ, and Tremandraceæ of the latter series on the other (BENTH.-HOOKER); and also in those of the Hamamelidaceæ and Simarubaceæ[5] in the presence of a ring of secretory-canals in the medulla-crown. To the Myrtifloræ, its alliance is, in some measure, to be seen in a few similarities of the Rosaceæ[6] on the one hand, and of the Combretaceæ, Myrtaceæ and Thymelæaceæ on the other. The relation between the Rosales and the Sapindales is rather slight, as can be seen from some agreement of the Saxifragaceæ and the Melianthaceæ[7] and from that of the Pittosporaceæ[8] and Celastraceæ in their floral diagram. To the Rhamnales, the Rosales are on some degree related, as is shown in the Pittosporaceæ[9] and Rhamnaceæ (R. BROWN); and also to the Umbellifloræ, in some conformities of the Pittosporaceæ and Araliaceæ, and of the former family and the Umbelliferæ, in the peculiar distribution of the resin-ducts in the roots, in the formation of lateral roots and in other anatomical characters (VAN TIEGHEM)[10]. Lastly, they are somewhat related to the Rubiales in the slight agreement of the Saxifragaceæ and Adoxaceæ.[11] As has been pointed out, the relations of the Rosales in this point or that extend from the Santalales far up to the Rubiales. Their natural position is, therefore, dynamic.

Next to the Rosales in his syllabus, ENGLER places the Pandales[12]. As to the relations of the latter series, we are as yet ignorant.

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1) l. c. III.—6, p. 166.
2) l. c. III.—6, p. 252.
3) l. c. III.—6, p. 131.
4) l, c. III.—2, a, p. 108.
5) Nat. Pfl.-fam. III.—5, p. 203 and III.—6, p. 253.
6) l. c. III.—3, p. 10.
7) l. c. III.—5, p. 378.
8) l. c. III.—2, a, p. 108.
9), 10) Nat. Pfl.-fam. III.—2, a, p. 108.
11) l. c. IV.—4, p. 171.
12) ENGLER, A. — Syllabus l. c. p. 223.

He then refers to the Geraniales and Sapindales and says[1]:—

> Bei den beiden Reihen der *Geraniales* und *Sapindales* wird die cyklische Anordnung der Blütenteile vollständig; aber die noch häufig vorkommende unvollständige Vereinigung der Carpelle ist ein Grund für die Stellung beider Reihen vor den *Malvales* und *Parietales*. Beide Reihen stehen einander sehr nahe und lassen sich nur dann unterscheiden, wenn man die in der Charakteristik angegebenen Merkmale der Samenanlage in den Vordergrund stellt. Jede der Reihen beginnt mit den Familien, in welchen noch Isomerie des Gynäceums vorkommt, dann folgen diejenigen, bei denen die Oligomerie herrscht.

This is indeed true, but it is so only according to the view upon which ENGLER dwells. In other respects, the case is quite otherwise; for, in this point or that the relations of the Geraniales to other series, as will be seen in course, are of wide extent reaching from the Centrospermæ, perhaps even from the Coniferæ, far up to the several series of the Metachlamydeæ. The Sapindales also are extensively allied to other series, their relations ranging from the Coniferæ far up to the Primulales. The natural positions of these two series should be changeable with the criteria employed.

In the first place, let us consider the natural relations of the Geraniales. Their connections with the Rhœadales, Centrospermæ, and Rosales have already been referred to. Perhaps the closest alliance is manifested between the Geranials and the Sapindales. The relationship is very complicated. To begin with the Geraniaceæ, we find that they in many features are similar to the Corynocarpaceæ[2] (after VAN TIEGHEM), to the Limnanthaceæ[3], and to the Balsaminaceæ[4] (after BENTH.-HOOKER). Then, most closely the Tropæolaceæ are related to the Balsaminaceæ[5] (BENTH.-HOOK.). Some of the Zygophyllaceæ are allied to the Melianthaceæ[6], in the presence of calcium oxalate in the form of styloiden (RADLKOFER); the Rutaceæ, though rather slightly, to the Sapindaceæ[7]; the Simarubaceæ, to the Sapindaceæ also slightly; the Burseraceæ[8], to the Anacardiaceæ[9], in the resin-canals and in other anatomical characters; the Meliaceæ[10], to the Sapindaceæ in the secretory-cells; the Malpighiaceæ[11], to the latter family in the habit, in the winged

1) ENGLER, A. — Erläuterungen, l. c. p. 366.
2) Nat. Pfl.-fam. Nacht. III. p. 197.
3) l. c. III.—5, p. 136.
4) l. c. III.—5, p. 388.
5) l. c. III.—5, p. 388.
6) l. c. III.—5, p. 378.
7) l. c. III.—5, p. 298.
8) l. c. III.—4, p. 233.
9) l. c. III.—5, p. 144.
10) l. c. III.—4, p. 266.
11) l. c. III.—4, p. 52.

fruits and in the oblique symmetry of the flowers; the Malpighiaceæ[1], to the Balsaminaceæ, in the oblique symmetry of the flowers; the Trigoniaceæ[2], to the Balsaminaceæ, Hippocrateaceæ and Sapindaceæ; the Vochysiaceæ, to the Balsaminaceæ[3]; and finally the Euphorbiaceæ[4], to the Empetraceæ (EICHLER) and to the Celastraceæ[5], as can be seen in a certain degree of agreement between *Drypetes* (Euph.) and *Elæodendron* (Celast.). The relation of the Geraniales to the Parietales is shown clearly in the accord of the Linaceæ[6] with the Ternstrœmiaceæ, in that of the Simarubaceæ with the Dipterocarpaceæ[7] in the presence of a ring of secretory-canals in the medulla-crown, and in the greater or less resemblance of the Malpighiaceæ and the Ancistrocladaceæ.[8] Their alliance to the Myrtifloræ is indicated by the resemblance of the Vochysiaceæ[9] and the Oenotheraceæ (DE CANDOLLE, WARMING, EICHLER), and by that of the Callitrichaceæ[10] and the Halorrhagaceæ[11] (DE CANDOLLE, BENTH.-HOOK.). With the Rhamnales, the connection is found in the agreement of the Geraniaceæ and the Rhamnaceæ, as can be seen in the floral diagram of *Geranium* and *Rhamnus*[12]. Their relation to the Sympetalæ is rather apparent, as is shown in the gamopetalous genera *Stephanopodium* and *Tapura* (which is even zygomorphous) of the Dichapetalaceæ[13], and in the fruit and single coated ovules of the Callitrichaceæ[14]. Finally, their relation to the Coniferæ should be considered; the presence of the similar resin-ducts in the Burseraceæ[15] on the one hand and in the Pinaceæ on the other is so striking that we are compelled to take this character as representing one of their natural relations.

Secondly, we shall consider the natural relations which the Sapindales bear to other series and see whether it is really natural to place this series, in any case, together with the Geraniales, before the Malvales and the Parietales. Its relations to the Julianiales, Santalales, Ranales, Geraniales,

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1) Nat. Pfl.-fam. III.—5, p. 388.
2) l. c. III.—4, p. ?
3) l. c. III.—5, p. 388.
4) l. c. III.—5, p. 13.
5) l. c. III.—5, p. 198.
6) l. c. III.—4, p. 30.
7) l. c. III.—6, p. 252.
8) Nat. Pfl.-fam. III.—6, p. 276.
9) l. c. III.—4, p. 315.
10) l. c. III.—5, p. 122.
11) l. c. III.—7, p. 230.
12) WETTSTEIN, R. R. — l. c. p. 613.
13) Nat. Pfl.-fam. III.—4, p. 347.
14) l. c. III.—5, p. 122.
15) Nat. Pfl.-fam. III.—4, p. 333.

Juglandales and Rosales, all belonging to the Archichlamydeæ, have been alluded to above. It remains to compare it with the Matachlamydeæ. As to the Ebenales and the Tubifloræ, their relations to the present series are manifest in the single coated ovules in the Limnanthaceæ[1], in the partial agreement of the Salvadoraceæ[2] with the Oleaceæ, and in that of the Aquifoliaceæ[3] with the Symplocaceæ. As to the affinity of the Sapindales and the Ericales, this is suggested in the agreement of the Cyrillaceæ[4] and the Ericaceæ, in the habit and in the peculiar anther of *Costœa* of the former family, and of the Pentaphylacaceæ[5] and the Clethraceæ in the pored anthers and the capsules. Further, some relation is to be found between the Sapindales and the Primulales, as can be seen in a comparison of the Corynocarpaceæ[6] and the Myrsinaceæ (G. Don, Endlicher). Finally, their relation to the Coniferæ, as in the case of the Geraniales, is shown by the presence of the very similar resin-ducts in the Anacardiaceæ[7] and the Pinaceæ. As can be seen from the statements above given, the groups so far considered are not to be regarded as serially related, but are in close intermixed relations. To arrange them in one order or another is quite right in this respect or that. One can not have a claim superior to another. Natural positions for the two series are found in several places between the Coniferæ and the Metachlamydeæ.

Next, come the Rhamnales[8]. As to this series, he says:—

> Die **Rhamnales** sind jetzt auf die tetracyklischen Archichlamydeen mit vor den Blb. stehenden Stb. beschränkt. Da bei den *Rhamnaceæ* die Stellung der Raphe an der aufsteigenden Sa. sehr wechselnd ist, so können die *Vitaceæ*, welche immer ventrale Raphe haben, unbedenklich neben die *Rhamnaceæ* gestellt werden.

Its relations to the Rosales and Geraniales have already been referred to. Its relation to the Umbellifloræ is, in my estimation, undeniable. A comparison of the Vitaceæ[9] with the Araliaceæ and the Umbelliferæ will at once justify this conclusion. One might object to the above statement on the ground that the Rhamnales have stamens opposite the petals, while the Umbellifloræ have stamens alternate to the petals. But this, in my opinion, makes no great

1) Wettstein, R. R. — l. c. p. 617.
2) Nat. Pfl.-fam. IV.—2, p. 19.
3) According to Dr. R. Kanehira, both families are very similar in anatomical characters.
4) Nat. Pfl.-fam. III.—5, p. 180.
5) Nat. Pfl.-fam. Nacht. I. p. 215.
6) l. c. Nacht I. p. 217.
7) l. c. III.—4. p. 234. (Burseraceæ).
8) Engler, A. — Erläuterungen, l. c. p. 367.
9) Nat. Pfl.-fam. III.—8, p. 111.

difference. Take the Loranthaceæ for an example, you will there find both types, some with stamens opposite, and some with them alternate, to the pelals, as in the male flowers of *Eremolepis*[1] and *Bifaria* (or in my *Pseudixus*[2]). Such great stress is put upon the relative positions of stamens and petals, only because the conservation of the present static system demands it. The natural position of the Rhamnales should, therefore, be dynamic.

Then come the Malvales[3] according to ENGLER'S system. Their relation to the Geraniales has been pointed out. Moreover, the Malvales bear a close resemblance to the Parietales, as is indicated in a comparison of the Elæocarpaceæ[4] with some (*Prockia* and *Hasseltia*) of the Flacourtiaceæ[5]; of the Chlænaceæ[6] with some (Asteropeieæ) of the Theaceæ[7] (BAILLON); of the former family[8] with the Dipterocarpaceæ; of the Tiliaceæ[9] with the Flacourtiaceæ; and in the agreement of the Tiliaceæ[10] with the Bixaceæ[11] in the palmate nerves of the leaves, in the stamens connate at their base, in the pored anthers, in the loculicidal dehiscence of the fruit, in the hairy covering of the seeds, in the flat cotyledons, and in the mucilage canals in the medulla, cortex and leaves. Further, the relation of the Malvales to the Tubifloræ is shown in the conformity of the Malvaceæ and the Convolvulaceæ[12] in the hairy covering of the seeds, in the curved embryo and in the secondary meristematic zone in the xylem. The natural position of the Malvales, as it were, occilates between the Geraniales and the Tubifloræ.

As to the Parietales[13], ENGLER says:—

> Wie schon oben angedeutet wurde, reicht die Reihe der **Parietales** mit ihren ersten Familien bis in die Nähe der *Ranales*. Die *Dilleniaceæ* wurden denselben früher auch zugerechnet, zeigen aber auch Beziehungen zu den Familien der *Eucryphiaceæ, Ochnaceæ, Caryocaraceæ, Marcgraviaceæ, Quiinaceæ, Theaceæ, Guttiferæ* und *Dipterocarpaceæ*, welche alle einander nahe stehen, und alle darin übereinstimmen, dass das

1) EICHLER, A. W. — Blüthendiagramme, construirt und erläutert (1875), p. 553.

2) HAYATA, B. — On *Pseudixus*, on new genus of Loranthaceæ, founded on the well-known and widely distributed species *Viscum japonicum* THUNB., in Bot. Mag. (Tōkyō) Vol. XXIX. pp. 31–34.

3) ENGLER, A. — Erläuterungen, l. c. p. 367.

4) Nat. Pfl.-fam. III.—6, p. 3.

5) Nat. Pfl.-fam. III.—6, a, p. 10.

6) l. c. III.—6, p. 172.

7) l. c. III.—6, p. 179.

8) l. c. III.—6, p. 172.

9) l. c. III.—6, p. 13.

10) l. c. III.—6, p. 13.

11) l. c. III.—6, p. 309.

12) l. c. IV.—3, a, p. 11.

13) ENGLER, A. — Erläuterungen, l. c. p. 367.

Nährgewebe ihrer Samen Öl und Proteïnkörner enthält. Ich fasse sie als Unterreihe *Theineæ* zusammen. Spiralige Anordnung und unbestimmte Zahl der Blütenphyllome kommt bei mehreren dieser Familien noch vielfach vor; und bei den *Ochnaceæ* kann man ebensowohl apocarpe Gynäceen wie syncarpe, teils mit centralwinkelständigen, teils mit wandständigen Placenten antreffen.

The above statement plainly shows that the Parietales are a very heterogeneous group which is related to several other series. Its relations to the Sarraceniales, Rhœadales, Ranales, Rosales, Sapindales, Salicales, Geraniales, Malvales and Centrospermæ have been pointed out. It is also allied to the Umbellifloræ, as the Dipterocarpaceæ[1] are connected with the Cornaceæ by the presence of a ring of secretory canals in the medulla-crown in *Martinia* (VAN TIEGHEM). Moreover, its alliance with the Myrtifloræ is manifested in the analogous features of the Elatinaceæ[2] and the Lythraceæ (BARTLING); of the Passifloraceæ and the Thymelæaceæ[3], in the receptacle and its effiguration, in the frequently stalked ovary, and in many other characters; of the Loasaceæ[4] on the one hand and the Lythraceæ, Myrtaceæ (EICHLER) and Oenotheraceæ on the other (De CANDOLLE and EICHLER). The resemblance which the Parietales bear to the series of the Archichlamydeæ has been fully stated above. It remains to compare them with other series of the Metachlamydeæ. They have some relationship to the Tubifloræ, as can be seen in the agreement of the Fouquieriaceæ[5] and the Polemoniaceæ in the 3-celled ovary, in the more or less connate styles, and in the tubiform corolla with stamens at its base. Also they in some measure approach the Ebenales, as the Guttiferæ show some analogy in fruit with the Ebenaceæ[6], and the Theaceæ bears some resemblance to the Styracaceæ. A connection between the Parietales and the Rubiales is to be found in a comparison of the Loasaceæ[7] on the one hand and the Dipsacaeæ on the other (BENTH.-HOOK.). Further, the Parietales are allied to the Cucurbitales, as the Cucurbitaceæ[8] show some resemblance to the Passifloraceæ (BENTH.-HOOK.); to the Achariaceæ[9], in the gamophyllous corolla; to the Caricaceæ[10], in the structure of the ovules (VAN TIEGHEM); to the Loasaceæ[11]

1) Nat. Pfl.-fam. III.—6, p. 252.
2) l. c. III.—6, p. 279.
3) l. c. III.—6, a, p. 221.
4) l. c. III.—6, a, p. 106.
5) Nat. Pfl.-fam. Nacht. III. p. 228.
6) Nat. Pfl.-fam. IV.—1, p. 156.
7) l. c. III.—6, a, p. 106.
8) l. c. IV.—5, p. 8.
9) l. c. Nacht. I. p. 256.
10) l. c. III.—6, a, p. 98 and Nacht. III. p. 235.
11) l. c. III.—6, a, p. 106.

(BAILLON); and lastly to the Begoniaceæ[1] (BAILLON) in the unisexual flowers, in the inferior ovary, in the connate stamens, in the leaf-venation, in the placenta and in the exalbuminous seeds. Another instance of the transition from the Parietales to the Metachlamydeæ can be seen in the gamopetalous genera of the Theaceæ, such as *Eurya* and *Anneslea*. Moreover, some connections may be found between the Parietales and the Ericales, when we compare the Stachyuraceæ[2] and Clethraceæ (BAILLON). As is stated above, the relation of the Parietales in one point or another to other series is of wide extent, reaching from the Salicales or the Centrospermæ far up to the Cucurbitales. At one time we consider their gamopetalous character, and place them in the Metachlamydeæ. At another time their polypetalous genera make them assignable to the Archichlamydeæ. The systematic position of the series should, therefore, be dynamic. As to the families in this series, it is absolutely impossible to arrange them serially, as they inter-relate one another like the methes of a net. To this fact, I shall return later on. What ENGLER mentions, in this case, partly confirms the above statement. He says[3]:—

> Eine solche Reihe wie die *Parietales* ist nicht ein einheitlicher monophyletischer Verwandtschaftskreis, sondern ein Complex von mehreren Verwandtschaftskreisen, die teilweise von verschiedenen Anfangspunkten ausgehend in ihrer Entwickelung auf derselben morphologischen Hauptstufe Halt gemacht haben, teilweise, wie die Unterreihe der *Flacourtiineae* noch verschiedene Hauptstufen der Entwickelung erkennen lassen.

But, when this series had been described by ENGLER as a complex of many groups, how then is it possible to give it a fixed place? The answer should decidedly be negative.

Next, in ENGLER's system follow the Opuntiales[4]. As has already been stated, they bear resemblance in a greater or less degree to other series; to the Ranales in the spiral arrangement of the floral elements, to the Parietales in the structure of the ovary, and to the Centrospermæ in the relative position of the sepals, petals and stamens. Consequently, their natural position changes from this place to that according to the way in which they are considered.

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1) Nacht. Pfl.-fam. III.—6, a, p. 133. 2) l. c. III.—6, p. 193.

3) ENGLER, A. — Erläuterungen, l. c. p. 368.

4) ENGLER, A. — Erläuterungen, l. c. p. 369.

Next, come the Myrtifloræ. We have thus far referred to the relation which this series bears to the Ranales, Rosales, Parietales, and Geraniales. Further, the connection of the Myrtifloræ with the Umbellifloræ is shown in the araliaceous genera[1] with numerous anthers and carpels. The position of the series should, therefore, be dynamic.

Finally, at the end of the Archichlamydeæ comes the Umbellifloræ. Their relations to the Santalales, Parietales, Rosales, Myrtifloræ, Rhamnales have been discussed under each heading. Fnrther connection is to be found in the Rubiales, as can be seen in a comparison of the Araliaceæ with the Adoxaceæ[2]; and of the Umbelliferæ with the Rubiaceæ[3], in having 5-stamens in one whorl, in the 2-celled inferior ovary, and especially in the fruit of the Psychotrieæ and the Pæderieæ (JUSSIEU, C. DE CANDOLLE). According to different views, the Umbellifloræ are related all the way from the Santalales up to the Rubiales. Thus their position should be a dynamic one.

Now, we arrive at the other subclass Metachlamydeæ, concerning which ENGLER says[4]:—

> Bezüglich der Sympetalen sind schon mehrfach Zweifel daran geäußert worden, dass dieselben monophyletisch seien; das ist auch gewiss nicht der Fall; aber ebenso sicher ist auch, dass die Reihen der Sympetalen nicht gewissermaßen als Fortsetzung der Reihen der *Archich'amydeæ* anzusehen sind............ Die Unterklasse der *Metachlamydeæ* oder *Sympetalæ* umfasst also solche Familien, bei denen das gemeinsame vereinte Emporwachsen der Blumenblattanlagen die Regel geworden ist.

The Metachlamydeæ are, therefore, a complex of families which agree only in having the gamophyllous corolla, but differ from one another in other characters. Consequently, when grouped according to a criterion other than the gamophyllous corolla, some of the Metachlamydeæ should be united with some of the Archichlamydeæ, and as a result, we have quite different groups in the place of the two subclasses named. The natural relation is really and solely made comprehensible by such an alteration of grouping; but never in the artificial (though so-called natural) static system, which does not admit of the co-existence of any another system.

As to the position of the Ericales[5] and Primulales[6], ENGLER says:—

1) ENGLER, A.—l. c. p. 369.
2) Nat. Pfl.-fam. IV.—4, p. 171.
3) l. c. IV.—4, p. 13.
4) ENGLER, A.—Erläuterungen, l. c. p. 369.
5), 6) ENGLER, A.—l. c, p. 369.

> Naturgemäß gehören an den Anfang der Sympetalen die beiden Reihen der **Ericales** und **Primulales**, bei welchen noch getrennte Blumenblätter vorkommen, und noch 2 Staubblattkreise typisch sind, während bei den übrigen Reihen mit Ausnahme der *Ebenales* stets nur noch ein Staubblattkreis entwickelt wird.

This is, indeed, true in that respect, but only in that respect; in other respects, it is not true. This we shall see presently. The relation of the Ericales to the Verticillatæ, Fagales, Parietales, and to the Sapindales is incontestable, as has been shown above. Besides, the Ericales are allied to the Campanulatæ, as can be seen in the agreement of the Ericaceæ[1] and the Campanulaceæ in the insertion of the stamens. Further, its relation to the Primulales[2] is manifest in the similarity of the *Schizocoden* (Diapens.) and *Soldanella* (Primulaceæ). Thus, the Ericales stand in different relations to the Parietales, the Sapindales, the Primulales and even to the Campanulatæ respectively. Their natural position cannot to be fixed at the beginning of the Metachlamydeæ; they may be placed among the Archichlamydeæ in one respect, but according to another view may be among the Metachlamydeæ close to the Campanulatæ.

The relations of the next series, the Primulales, to the Sapindales and to the Ericales have been discussed. The connection of the series with the Plumbaginales[3] is manifest in the agreement of the three following families, the Primulaceæ, the Myrsinaceæ and the Plumbaginaceæ in the floral diagram, in the five-carpelled, one-celled ovary with a basal placenta and in the double-coated ovules. That the Primulales are related to the Tubifloræ will be seen in the agreement of the Primulaceæ and Lentibulariaceæ[4] in the central placenta. Further, some connection with the Primulales may be found in the Ebenales, as the Myrsinaceæ[5] agree with the Sapotaceæ in the floral diagram. That the Primulales are, therefore, in one respect or another related to the Sapindales and thence all the way up to the Plumbaginales is evident, even so far as our present limited knowledge is available. Its natural position should, at any rate, be dynamic.

Next, in his syllabus Engler places the Plumbaginales[6] and then the Ebenales[7]. The real natural relations of the latter series are with the Primulales,

1) Nat. Pfl.-fam. IV.—1, p. 30.
2) l. c. IV.—1, p. 81.
3) Nat. Pfl.-fam. IV.—1, pp. 104 and 121.
4) l. c. IV.—3, b, p. 117.
5) l. c. IV.—1, p. 87.
6) Engler, A. — Syllabus l. c. p. 236.
7) Engler, A. — Erläuterungen, l. c. p. 370.

Ranales, Parietales, and Sapindales, as shown in the discussions thus far. Its position is, therefore, cannot be so definitely determined as in ENGLER's system, but should be changeable like the other series.

Regarding the Contortæ ENGLER states[1] :—

> Die Reihe der **Contortæ** ist keineswegs scharf von der folgenden umfangreichen Reihe der *Tubifloræ* zu unterscheiden; aber, wie schon mehrfach betont, giebt bei der Aufstellung natürlicher Verwandtschaftskreise nicht ein durchgreifendes Merkmal den Ausschlag, sondern es handelt sich hauptsächlich um die Entwickelungstendenzen, welche in einer Sippe hervortreten. Als solche können wir für die *Contortæ* anführen, dass die Abschnitte der Blumenkrone sich meistens contort decken und die Carpelle häufig nicht vollständig vereint sind. Keines dieser Merkmale ist durchgreifend.

This statement proves that the Contortæ imply various heterogenous families. Their relations to the other series are accordingly very complicated. The resemblance of the Contortæ and the Sapindales has been indicated under the latter series. Their connection with the Tubifloræ will be seen in the agreement of the Oleaceæ and the Columelliaceæ[2], in the woody structure, in the opposite exstipulate leaves and in the flowers with 2-stamens. The same is also observed in the greater or less resemblance between the Loganiaceæ[3] and the Solanaceæ (BAILLON), and between the Loganiaceæ and the Scrophulariaceæ. Their relation to the Rubiales is very clear when we examine the connection of the Loganiaceæ with the Rubiaceæ and especially with *Gärtnera* and *Pogamea*,[4] both of the latter family; and also the agreement of the Apocynaceæ[5] and Rubiaceæ, in the stipule and in the opposite leaves. Finally their alliance to the Campanulatæ is manifested in the Gentianaceæ and Goodeniaceæ[6], as can be seen in a comparison of *Limnanthemum* of the former family, with *Velleia* of the latter. The natural position of the series is, therefore, plainly dynamic.

Then, ENGLER comes to refer to the Tubifloræ[7]. Their relations to the Malvales, Parietales, Contortæ, Primulales and Rhœadales have already been pointed out. Also to the Rubiales, they bear some resemblance which is shown in the Bignoniaceæ and Henriquezieæ of the Rubiaceæ[8]. Thus, the series is related to the Rhœadales and all the way up to the Rubiales in this point or that. Its position should, therefore, be dynamic.

1) ENGLER, A. — l. c. 370.
2) Nat. Pfl.-fam. IV.—3, b, p. 187.
3) l. c. IV.—2, p. 27.
4) Nat. Pfl.-fam. IV.—4. p. 13.
5) l. c. IV.—2, p. 118.
6) l. c. IV.—5, p. 74.
7) ENGLER, A. — Erläuterungen, l. c. p. 370.
8) Nat. Pfl.-fam. IV—.4, p. 13.

Next, come the Plantaginales[1]. Their relation to the Tubifloræ has been given above. They are closely allied to the Campanulatæ in the conformity observable in the Plantaginaceæ[2] and some genera of the Campanulaceæ in the tetramerous flowers, in the superior ovary, in the absence of the medullary rays and in the occasional presence of vessels in medulla and cortex. Further, some connection between the Plantaginales and the Tubifloræ is found when the Plantaginaceæ and the Borraginaceæ are compared.

Then, follow the Rubiales[3]. As has been discussed above, their connections are manifestly with the Parietales, Rosales, Umbellifloræ and Tubifloræ, in this point or that. Nevertheless, the series seems unrelated to any other, either closely or loosely, in point of its being near to, or far from, the latter, so far as is shown in ENGLER's system. But, on the contrary, its relations are generally exhibited with little regard to nearness or remoteness. Its position should, therefore, be dynamic.

Next, come the Cucurbitales[4]. When we regard this series as incorporated in the Campanulatæ, then the position of the latter series becomes very dynamic, as can be seen in a comparison of the Campanulatæ with the Parietales, Tubifloræ, Plantaginales, Contortæ and Rubiales. But, on the contrary, when we think of the Cucurbitales as independent from the Campanulatæ, then the Cucurbitales are related to the Parietales and Tubifloræ, as has been discussed above, and also to the Campanulatæ as can be seen in a comparison of the Cucurbitaceæ[5] and the Campanulaceæ[6] (A. BRAUN). Its position becomes in consequence less dynamic.

Finally, come the Campanulatæ. These are related to the Ericales, Cucurbitales, Plantaginales, Contortæ and Rubiales, as appears in this point or that of the discussion thus far. Their position should, therefore, be dynamic.

The consideration of ENGLER's system thus far, when taken together with his principle and his explanation, forces me to conclude that his system is a complex of many partial manifestations of a real natural system, and that it is a system constructed principally with the view of consulting our own con-

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1) ENGLER, A. — Erläuterungen, l. c. p. 370. 2) Nat. Pfl.-fam. IV.—3, b, p. 369.
3) ENGLER, A. — Erläuterungen, l. c. p, 371. 4) ENGLER, A. — Syllabus, l. c. p. 338.
5) Nat. Pfl.-fam. IV,—5, p. 8. 6) Nat, Pfl.-fam. IV.—5, p. 47.

venience. If a natural system should be found to explain all the mutual relations of all the members of the system, it would be a dynamic one.

8. Construction of the dynamic system.

The question now arises as to how to construct the dynamic system. The best and simplest way of doing this is to take a static system like ENGLER'S or BENTHAM-HOOKER'S, as a foundation, or rather as a framework, and to put it, so to speak, into a dynamic condition. To this matter, I shall return later on, but let us now proceed to discuss the reasons for so doing.

However different may be the static system taken at first as a framework, the dynamic system, after it is completed, is ever the same in its real meaning. It is only the appearance of the system that varies with the framework. ENGLER'S system is different from BENTHAM-HOOKER'S; but the difference is merely because of the difference of ENGLER'S view from BENTHAM-HOOKER'S. When we take ENGLER'S system as a framework or, so to speak, as a starting point, for the construction of a dynamic system, the latter system is quite the same in its real meaning as that constructed by taking BENTHAM-HOOKER'S system. This work of construction is something like a cruise round the world. However much the starting point may be shifted, after the voyage is finished, the ports we have called at are all the same. Let me take another metaphor to explain my idea correctly. To establish natural relations, which is the principal object of constructing a natural system, is, as it were, to acquire a thorough understanding of the features of a mountain. As an example, take Mt. Fuji, that fitting emblem of the Japanese nation and my special favourite since my youth. As a natural system has several different aspects, so has the volcano. As the former should be considered from different points of view, so should be the

latter, from different sides. Now, allow me to describe the varying features of the mountain as a momentary digression from our lengthy and rather formal discussion.

When the mountain is observed from the south-west, the plant regions on its sides are seen to be displayed very clearly by the different elevations of the formations; the truncated cone, clad in pure white snow, or sometimes crowned with clouds; the hazy dark green region of the conifer-forest in the middle; a little lower the light red zone of the deciduous forest; then the light brown which extends to the base, and merges into mile after mile of prairie-formation. This view is, as it were, comparable to ENGLER'S system. Now, moving eastwards to the Gotemba-plain, we have a full view from the south-east, but this is rather limited on the south-west by an area bordered by Mt. Ashitaka. In the spring, when the snow still remains on the peak, the dark green belt of the pine forest stands in clear relief against the background of the pure white snow. This belt is thick on the north, but becomes thinner and broader on the south, extending down the flank to the middle of the mountain, and then giving way to the prairie which stretches far and wide to the fertile plain of Gotemba. This aspect seems somewhat like BENTHAM-HOOKER'S system. Now passing on to the north side, let us sketch the view from the top of the Misaka-pass. Here one gets a glorious view of the truncated cone, late in the spring when the snow covers the peak above and the prairie below, but leaves the green of the pine-forest doubly dark against the pure white snow. The prairie is equally broad and extensive as in the view from the south-east, but is broken by lava-streams which show themselves here and there by the forest upon them. The deciduous tree formation is but faintly represented on this side. This view is, figuratively speaking, like EICHLER'S system. Now, let us turn our attention to the north-west side. The coniferous formation has here its most luxuriant growth. The conifers stretch all the way from the middle to the base. The deciduous forest is very poor and the prairie covers but a small area. A bird's-eye view from the top of the Konno-pass shows this part clad with evergreen conifers stretching like a level sea, mile after mile of dark purple, broken only by the mountain-range beyond. This view is, so to

speak, comparable to DE CANDOLLE'S system[1].

Thus having completed our circuit of Mt. Fuji, let us consider the beautiful vegetation of the mountain. However different be our starting point, after having completed our circuit and combined the different views, the correct idea thus acquired of the mountain is always the same. So it is with the natural system. No matter what system we take for a first consideration, after having considered all relations in all views, the result should be always the same.

For the framework in constructing the dynamic system, I prefer ENGLER'S system to others, as it is the one most widely used by systematizers. For the present, I shall content myself with forming the system of the Angiosperms, as that class is the one with which I am most familiar, although I believe that systems for the other classes can be formed in the same manner. Now, to construct a dynamic system, arrange the series and families in the same order as in the system taken for a framework, and on both sides of a series or a family, put into such order as you like the several series or families respectively that are known to have some relations to the middle series or family, bearing in mind that the relative positions between the series or families thus arranged laterally and those in the middle vary with criteria. Next, put many short lines on both sides of the same series or families in the middle, a little more distant than the series or families already placed, keeping in view the fact that the lines denote series or families whose relations to the middle member are as yet unknown to us, though such surely exist, according to the participation theory. In the full extent of the latter theory, all the series and families, as many as are in the system, must necessarily be related in equal or different degree according as we consider the matter from the standpoint of universality or from that of particularity. The true method, therefore, in the above system-construction, is to arrange all series or families other than the middle one on both sides of the latter.

1) For the sake of convenience, I have here metaphorically compared different systems to different views of the mountain. Yet, speaking more correctly, a static system such as ENGLER'S is something like a mosaic picture of the mountain, one part of which is taken from one view, and another part of which is taken from another; while the real natural system is, as it were, comparable to the mountain itself.

Theoretically speaking, all the members (series as well as families) in the dynamic system should be mentioned repeatedly i. e. as many times as the number of series or families respectively. But, for practical purposes, the system may, as mentioned above, be simplified by arranging only those series or families whose relations to the middle members are so far known to us, and by adding thereto a few short lines symbolizing or representing as many series or families, other than those laterally arranged and the middle member. To make what we present to our readers as a dynamic system as comprehensible as possible, it may conveniently be formed of four parts, namely:— the participation theory upon which the system is grounded, the system itself, the explanation of the latter, and finally the index to the members of the system. Now, on the side of the reader, in order to understand thoroughly the dynamic system thus presented, they should, first of all, master the participation theory, then proceed to study the system itself, then look at the explanation of the latter, and finally go to the index, especially when they have something in mind, the natural position of which they wish to find in the system. These four parts are, however, in final analysis resolvable to oneness, — each being in itself the theory, each in itself the system, and so on. I have described the participation theory above; so I shall now give the system and then the explanation and the index, in the following pages.

9. The dynamic system of natural classification applied to the Angiosperms, with Engler's system as a framework.*

——— *Gymnospermæ* Subdivision **ANGIOSPERMÆ** ———

——— *Dicotyledoneæ* Class MONOCOTYLEDONEÆ ———

——— *Spathifloræ* Series **I. *Pandanales*** *Synanthæ* *Principes* ———

——— *Pandanaceæ* **1 Typhaceæ** Sparganiaceæ ———

——— *Araceæ* *Palmæ* **2 Pandanaceæ** Sparganiaceæ Typhaceæ ———
——— *Cyclanthaceæ* ———

——— *Araceæ* *Gramineæ* **3 Sparganiaceæ** Pandanaceæ Typhaceæ ———

——— *Triuridales* *Liliifloræ* Series **II. *Helobiæ*** *Spathifloræ* *Microspermæ* ———
——— *Farinosæ* *Ranales* ———

——— Hydrocharitaceæ **4 Potamogetonaceæ** Scheuchzeriaceæ ———
——— Alismataceæ *Araceæ* Najadaceæ Aponogetonaceæ ———

——— *Ceratophyllaceæ* **5 Najadaceæ** Potamogetonaceæ ———
——— Hydrocharitaceæ Scheuchzeriaceæ (=Juncaginaceæ) ———

——— Scheuchzeriaceæ Alismataceæ **6 Aponogetonaceæ** Potamogetonaceæ ———

——— Potamogetonaceæ **7 Scheuchzeriaceæ** (=*Juncaginaceæ*) Alismataceæ ———

——— Scheuchzeriaceæ Aponogetonaceæ **8 Alismataceæ** Butomaceæ Potamogetonaceæ ———
——— *Ranunculaceæ* Hydrocharitaceæ *Triuridaceæ* ———

——— Hydrocharitaceæ **9 Butomaceæ** Alismataceæ *Triuridaceæ* ———

——— Butomaceæ Potamogetonaceæ **10 Hydrocharitaceæ** Alismataceæ *Bromeliaceæ* ———
——— *Iridaceæ* *Amaryllidaceæ* *Burmanniaceæ* *Mayacaceæ* Najadaceæ ———

——— *Dicotyledoneæ* Series **III. *Triuridales*** Helobiæ *Microspermæ* ———

——— *Alismataceæ* *Orchidaceæ* **11 Triuridaceæ** *Burmanniaceæ* *Dicotyledoneæ* ———
——— *Butomaceæ* ———

——— *Farinosæ* Series **IV. *Glumifloræ*** *Liliifloræ* ———

——— *Juncaceæ* **12 Gramineæ** Cyperaceæ *Sparganiaceæ* ———

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* The arrangement of families on the right, left or under side of a framework-family has nothing to do with their natural relations; but the printing of names in Roman type shows that such families are referable to the same series to which the family in gothic type in the middle column belongs; while the names in Italics are those of families assignable to a series different from that to which the family in the middle column is referred.

——— *Eriocaulaceæ* Gramineæ **13 Cyperaceæ** *Centrolepidaceæ* *Juncaceæ* ———
——— *Restionaceæ* ———

——— *Synanthæ* Series **V. *Principes*** *Pandanales* ———

——— *Cyclanthaceæ* **14 Palmæ** *Pandanaceæ* ———

——— *Pandanales* *Principes* Series **VI. *Synanthæ*** *Spathifloræ* ———

——— *Palmæ* *Pandanaceæ* **15 Cyclanthaceæ** *Araceæ* ———

——— *Helobiæ* *Synanthæ* Series **VII. *Spathifloræ*** *Pandanales* ———

——— *Taccaceæ* *Cyclanthaceæ* **16 Araceæ** Lemnaceæ *Pandanaceæ* ———
——— *Sparganiaceæ* *Potamogetonaceæ* ———

——— **17 Lemnaceæ** Araceæ ———

——— *Liliifloræ* *Glumifloræ* Series **VIII. *Farinosæ*** *Helobiæ* *Microspermæ* ———
——— *Scitamineæ* ———

——— *Juncaceæ* **18 Flagellariaceæ** Bromeliaceæ ———

——— *Cyperaceæ* Centrolepidaceæ **19 Restionaceæ** *Juncaceæ* Eriocaulaceæ ———

——— Eriocaulaceæ **20 Centrolepidaceæ** Restionaceæ ———

——— *Hydrocharitaceæ* **21 Mayacaceæ** Eriocaulaceæ ———

——— Eriocaulaceæ **22 Xyridaceæ** Rapateaceæ ———

——— Restionaceæ Rapateaceæ **23 Eriocaulaceæ** Mayacaceæ Centrolepidaceæ ———

——— **24 Thurniaceæ** As above ———

——— Xyridaceæ Eriocaulaceæ **25 Rapateaceæ** Bromeliaceæ ———

——— Rapateaceæ Mayacaceæ **26 Bromeliaceæ** Commelinaceæ Flagellariaceæ ———
——— *Orchidaceæ* *Amaryllidaceæ* *Liliifloræ* *Scitamineæ* *Hydrocharitaceæ* ———

——— Philydraceæ **27 Commelinaceæ** As above Bromeliaceæ ———

——— *Orchidaceæ* Cyanastraceæ **28 Pontederiaceæ** Philydraceæ *Liliaceæ* ———

——— *Hæmodoraceæ* **29 Cyanastraceæ** Pontederiaceæ ———

——— *Orchidaceæ* Pontederiaceæ **30 Philydraceæ** Commelinaceæ ———

——— *Glumifloræ* *Farinosæ* Series **IX. *Liliifloræ*** *Microspermæ* *Spathifloræ* ———
——— *Helobiæ* ———

——— *Gramineæ* *Flagellariaceæ* **31 Juncaceæ** Liliaceæ *Cyperaceæ* ———
——— *Restionaceæ* ———

——— ——— **32 Stemonaceæ** Liliaceæ ———

——— Hæmodoraceæ Amaryllidaceæ **33 Liliaceæ** Dioscoreaceæ Stemonaceæ ———
——— Velloziaceæ Juncaceæ *Pontederiaceæ* ———

——— Amaryllidaceæ Velloziaceæ **34 Hæmodoraceæ** Iridaceæ Liliaceæ ———
——— *Cyanastraceæ* *Burmanniaceæ* ———

——— Liliaceæ Dioscoreaceæ **35 Amaryllidaceæ** Iridaceæ Taccaceæ ———
——— *Bromeliaceæ* *Hydrocharitaceæ* Velloziaceæ Hæmodoraceæ ———
——— *Orchidaceæ* *Burmanniaceæ* ———

——— Amaryllidaceæ Hæmodoraceæ **36 Velloziaceæ** Iridaceæ Liliaceæ ———

——— *Dicotyledoneæ* Iridaceæ **37 Taccaceæ** Amaryllidaceæ Dioscoreaceæ ———

——— Amaryllidaceæ **38 Dioscoreaceæ** Taccaceæ Liliaceæ ———

——— Hæmodoraceæ Velloziaceæ **39 Iridaceæ** Amaryllidaceæ Taccaceæ ———
——— *Orchidaceæ* *Hydrocharitaceæ* ———

——— *Bromeliaceæ* Series **X.** ***Scitamineæ*** Microspermæ ———

——— *Orchidaceæ* Zingiberaceæ **40 Musaceæ** Cannaceæ Marantaceæ ———

——— *Orchidaceæ* Musaceæ **41 Zingiberaceæ** Marantaceæ Cannaceæ ———

——— *Orchidaceæ* Musaceæ **42 Cannaceæ** Zingiberaceæ Marantacæ ———

——— *Orchidaceæ* Musaceæ **43 Marantaceæ** Zingiberaceæ Cannaceæ ———

——— *Liliifloræ* *Farinosæ* Series **XI.** ***Microspermæ*** Helobiæ Scitamineæ ———
——— *Triuridales* ———

——— *Hæmodoraceæ* *Triuridaceæ* **44 Burmanniaceæ** Orchidaceæ *Amaryllidaceæ* ———
——— Hydrocharitaceæ *Taccaceæ* ———

——— *Marantaceæ* Burmanniaceæ **45 Orchidaceæ** *Triuridaceæ* *Amaryllidaceæ* ———
——— *Iridaceæ* *Bromeliaceæ* *Musaceæ* *Taccaceæ* *Zingiberaceæ* ———
——— *Hydrocharitaceæ* *Cannaceæ* *Philydraceæ* ———

——— *Monocotyledoneæ* Class DICOTYLEDONEÆ *Gymnospermæ* ———
——— *Taccaceæ* *Triuridaceæ* ———

——— Subclass **Archichlamydeæ** *Metachlamydeæ* ———

——— *Urticales* *Gnetales* Series **XII.** ***Verticillatæ*** *Juglandales* *Fagales* ———
——— *Ericales* ———

——— *Betulaceæ* *Gnetaceæ* **46 Casuarinaceæ** *Juglandaceæ* *Urticaceæ* ———
——— *Ericaceæ* ———

——— Series **XIII.** ***Piperales*** ———

——— **47 Saururaceæ** Piperaceæ ———

——— *Datiscaceæ* Lacistemaceæ **48 Piperaceæ** Saururaceæ Chloranthaceæ ———

——— *Hippuridaceæ* Piperaceæ **49 Chloranthaceæ** *Halorrhagaceæ* ———

——— **50 Lacistemaceæ** Piperaceæ ———

——— *Parietales* *Juglandales* Series **XIV. *Salicales*** *Batidales* *Myricales* ———
——— *Fagales* ———

——— *Tamaricaceæ* *Myricaceæ* **51 Salicaceæ** *Juglandaceæ* *Batidaceæ* ———
——— *Fagaceæ* *Betulaceæ* ———

——— Series **XV. *Garryales*** ———

——— **52 Garryaceæ** ———

——— *Salicales* Series **XVI. *Myricales*** *Fagales* *Juglandales* ———

——— *Juglandaceæ* *Salicaceæ* **53 Myricaceæ** *Fagaceæ* *Betulaceæ* ———

——— Series **XVII. *Balanopsidales*** *Geraniales* ———

——— *Euphorbiaceæ* **54 Balanopsidaceæ** *Fagaceæ* ———

——— Series **XVIII. *Leitneriales*** *Rosales* ———

——— *Hamamelidaceæ* **55 Leitneriaceæ** *Rosales* ———

——— *Sapindales* *Myricales* Series **XIX. *Juglandales*** Verticillatæ *Fagales* ———
——— *Salicales* *Julianiales* Urticales ———

——— *Salicaceæ* *Fagaceæ* **56 Juglandaceæ** *Anacardiaceæ* *Myricaceæ* ———
——— Urticaceæ *Casuarinaceæ* *Betulaceæ* *Julianiaceæ* ———

——— *Centrospermæ* Series **XX. *Batidales*** *Salicales* ———

——— *Chenopodiaceæ* *Amarantaceæ* **57 Batidaceæ** *Salicaceæ* *Phytolaccaceæ* ———

——— *Juglandales* Series **XXI. *Julianiales*** *Sapindales* *Fagales* ———

——— *Anacardiaceæ* **58 Julianiaceæ** *Fagaceæ* *Juglandaceæ* ———

——— *Balanopsidales* *Julianiales* Series **XXII. *Fagales*** *Verticillatæ* *Myricales* ———
——— *Salicales* *Juglandales* *Ericales* ———

——— *Salicaceæ* *Juglandaceæ* **59 Betulaceæ** *Casuarinaceæ* *Myricaceæ* ———
——— *Ericaceæ* *Fagaceæ* *Urticaceæ* ———

——— *Myricaceæ* *Juglandaceæ* **60 Fagaceæ** Betulaceæ *Julianiaceæ* ———
——— *Salicaceæ* *Ericaceæ* *Balanopsidaceæ* ———

——— *Verticillatæ* Series **XXIII. *Urticales*** *Fagales* *Juglandales* ———

——— Moraceæ **61 Ulmaceæ** Urticaceæ ———

——— Ulmaceæ **62 Moraceæ** Urticaceæ ———

——— *Datiscaceæ* Moraceæ **63 Urticaceæ** Ulmaceæ *Betulaceæ* ———
——— *Casuarinaceæ* *Juglandaceæ* ———

——— Series XXIV. ***Proteales*** *Santalales* ———

——— *Loranthaceæ* *Lauraceæ* **64 Proteaceæ** *Thymelæaceæ* ———

——— *Gymnospermæ* *Gnetales* Series XXV. ***Santalales*** *Myrtifloræ* *Rhamnales* ———
——— *Proteales* *Sapindales* *Rosales* ———

——— Santalaceæ **65 Myzodendraceæ** Loranthaceæ ———

——— Loranthaceæ Balanophoraceæ **66 Santalaceæ** Myzodendraceæ Olacaceæ ———
——— *Cynocrambaceæ* Grubbiaceæ *Gnetaceæ* *Balanophoraceæ* ———

——— **67 Opiliaceæ** ———

——— Santalaceæ **68 Grubbiaceæ** Olacaceæ Hamamelidaceæ ———

——— *Icacinaceæ* Grubbiaceæ **69 Olacaceæ** Santalaceæ Loranthaceæ ———

——— **70 Octoknemataceæ** ———

——— *Proteaceæ* *Vitaceæ* **71 Loranthaceæ** Olacaceæ Myzodendraceæ ———
——— *Araliaceæ* Balanophoraceæ Santalaceæ *Cornaceæ* ———

——— *Halorrhagaceæ* Loranthaceæ **72 Balanophoraceæ** Santalaceæ *Cynomoriaceæ* ———

——— Sarraceniales Series XXVI. ***Aristolochiales*** *Sympetalæ* *Ranales* ———

——— *Nepenthaceæ* *Ranales* **73 Aristolochiaceæ** Rafflesiaceæ Hydnoraceæ ———
——— *Anonaceæ* *Sympetalæ* *Nymphæaceæ* ———

——— *Anonaceæ* *Nepenthaceæ* **74 Rafflesiaceæ** Aristolochiaceæ *Nymphæaceæ* ———
——— Hydnoraceæ ———

——— Aristolochiaceæ As above **75 Hydnoraceæ** Rafflesiaceæ ———

——— Series XXVII. ***Polygonales*** Centrospermæ ———

——— *Amarantaceæ* **76 Polygonaceæ** *Plumbaginaceæ* ———

——— *Batidales* *Polygonales* Series XXVIII. ***Centrospermæ*** *Urticales* *Santalales* ———
——— *Parietales* *Rhœadales* *Geraniales* *Opuntiales* ———

——— Batidaceæ Phytolaccaceæ **77 Chenopodiaceæ** Basellaceæ Amarantaceæ ———
——— Portulacaceæ Cynocrambaceæ Aizoaceæ Nyctaginaceæ Caryophyllaceæ ———

——— *Polygonaceæ* Portulacaceæ **78 Amarantaceæ** Aizoaceæ Phytolaccaceæ ———
——— Chenopodiaceæ Caryophyllaceæ ———

——— Nyctaginaceæ **79 Nyctaginaceæ** Phytolaccaceæ ———

——— *Urticaceæ* Caryophyllaceæ **80 Cynocrambaceæ** *Santalaceæ* Chenopodiaceæ ———

——— Nyctaginaceæ Arizoaceæ **81 Phytolaccaceæ** Amarantaceæ Batidaceæ ———
——— *Tovaniaceæ* Cynocrambaceæ Caryophyllaceæ Chenopodiaceæ ———

——— *Cactaceæ* Amarantaceæ **82 Aizoaceæ** Portulacaceæ Caryophyllaceæ ———
——— Phytolaccaceæ Chenopodiaceæ ———

——— *Loasaceæ* Caryophyllaceæ **83 Portulacaceæ** Basellaceæ Amarantaceæ ———
——— Chenopodiaceæ ———

——— Portulacaceæ **84 Basellaceæ** Chenopodiaceæ ———

——— Amarantaceæ Aizoaceæ **85 Caryophyllaceæ** Portulacaceæ *Linaceæ* ———
——— Cynocrambaceæ *Callitrichaceæ* Nyctaginaceæ Chenopodiaceæ ———
——— *Pittosporaceæ* *Podostemonaceæ* Phytolaccaceæ *Elatinaceæ* *Frankeniaceæ* ———

——— *Rosales* *Ebenales* Series **XXIX. *Ranales*** *Sapindales* *Myrtifloræ* ———
——— *Urticales* *Coniferæ* *Rhœadales* *Sarraceniales* *Parietales* ———
——— *Helobiæ* *Aristolochiales* ———

——— *Aristolochiaceæ* *Papaveraceæ* **86 Nymphæaceæ** Ceratophyllaceæ Anonaceæ ———
——— *Sarraceniaceæ* Ranunculaceæ *Berberidaceæ* *Rafflesiaceæ* ———

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——— Nolanaceæ Verbenaceæ **254 Convolvulaceæ** Polemoniaceæ Solanaceæ ———
——— Acanthaceæ Hydrophyllaceæ Borraginaceæ *Malvaceæ* ———

——— *Fouquieriaceæ* **255 Polemoniaceæ** Convolvulaceæ *Diapensiaceæ* ———

——— Convolvulaceæ **256 Hydrophyllaceæ** Borraginaceæ ———
——— Scrophulariaceæ ———

——— Labiatæ Hydrophyllaceæ **257 Borraginaceæ** Convolvulaceæ Verbenaceæ ———
——— Nolanaceæ Myoporaceæ ———

——— Borraginaceæ Solanaceæ **258 Verbenaceæ** Labiatæ Scrophulariaceæ ———
——— Convolvulaceæ Phrymaceæ Myoporaceæ *Diapensiaceæ* ———

——— Acanthaceæ Scrophulariaceæ **259 Labiatæ** Verbenaceæ Borraginaceæ ———

——— Borraginaceæ **260 Nolanaceæ** Convolvulaceæ Solanaceæ ———

——— *Loganiaceæ* Verbenaceæ **261 Solanaceæ** Nolanaceæ Scrophulariaceæ ———
——— Myoporaceæ Convolvulaceæ ———

——— Myoporaceæ Acanthaceæ **262 Scrophulariaceæ** Bignoniaceæ Solanaceæ ———
——— Orobanchaceæ Globulariaceæ Pedaliaceæ Hydrophyllaceæ Verbenaceæ ———
——— Labiatæ Gesneriaceæ Lentibulariaceæ *Loganiaceæ* Phrymaceæ ———

——— Gesneriacæ Pedaliaceæ **263 Bignoniaceæ** Acanthaceæ Scrophulariaceæ ———
——— *Moringaceæ* *Rubiaceæ* ———

——— Martyniaceæ **264 Pedaliaceæ** Bignoniacæ Myoporaceæ ———
——— Scrophulariaceæ ———

——— Pedaliaceæ **265 Martyniaceæ** Gesneriaceæ ———

——— Gesneriaceæ **266 Orobanchaceæ** Scrophulariaceæ ———

——— Orobanchaceæ Martyniaceæ **267 Gesneriaceæ** Columelliaceæ Bignoniaceæ ———
——— Scrophulariaceæ ———

——— *Oleaceæ* **268 Columelliaceæ** Gesneriaceæ *Cucurbitaceæ* ———

——— *Primulaceæ* **269 Lentibulariaceæ** Scrophulariaceæ ———

——— *Dipsacaceæ* Scrophulariaceæ **270 Globulariaceæ** Myoporaceæ *Plantaginaceæ* ———
——— *Plumbaginaceæ* ———

——— Convolvulaceæ **271 Acanthaceæ** Scrophulariaceæ Labiatæ ———
——— Bignoniaceæ ———

——— Solanaceæ Phrymaceæ **272 Myoporaceæ** Scrophulariaceæ Verbenaceæ ———
——— *Oleaceæ* Globulariaceæ Borraginaceæ Pedaliaceæ ———

——— Scrophulariaceæ **273 Phrymaceæ** Verbanaceæ Myoporaceæ ———

——— *Tubifloræ* Series **XLVIII. *Plantaginales*** *Campanulatæ* ———

——— Stylidiaceæ *Campanulaceæ* **274 Plantaginaceæ** *Borraginaceæ Goodeniaceæ* ———
——— *Globulariaceæ* ———

——— *Rosales Campanulatæ* Series **XLIX. *Rubiales*** *Umbellifloræ Parietales* ———
——— *Archichlamydeæ Tubifloræ* ———

——— Compositæ Dipsacaceæ **275 Rubiaceæ** Caprifoliaceæ Valerianaceæ ———
——— *Umbelliferæ Polypetalæ Loganiaceæ Bignoniaceæ Apocynaceæ Cornaceæ* ———

——— *Cornaceæ* Valerianaceæ **276 Caprifoliaceæ** Rubiaceæ Adoxaceæ ———

——— *Saxifragaceæ Araliaceæ* **277 Adoxaceæ** Caprifoliaceæ ——— ———

——— Dipsacaceæ **278 Valerianaceæ** Caprifoliaceæ Rubiaceæ ———

——— *Calyceraceæ Loasaceæ* **279 Dipsacaceæ** Valerianaceæ Rubiaceæ ———

——— Campanulatæ Series **L. *Cucurbitales*** *Parietales Tubifloræ* ———

——— *Achariaceæ Begoniaceæ* **280 Cucurbitaceæ** *Loasaceæ Columelliaceæ* ———
——— *Campanulaceæ Caricaceæ Passifloraceæ Datiscaceæ* ———

——— *Contortæ Rubiales* Series **LI. *Campanulatæ*** *Ericales Cucurbitales* ———
——— *Plantaginales* ———

——— *Ericaceæ* Compositæ **281 Campanulaceæ** Stylidiaceæ Goodeniaceæ ———
——— *Cucurbitaceæ Plantaginaceæ* ———

——— Brunoniaceæ *Gentianaceæ* **282 Goodeniaceæ** Campanulaceæ *Plantaginaceæ* ———

——— *Plumbaginaceæ* **283 Brunoniaceæ** *Goodeniaceæ* ———

——— *Cucurbitaceæ* **284 Stylidiaceæ** Campanulaceæ *Plantaginaceæ* ———

——— ——— Dipsacaceæ **285 Calyceraceæ** Compositæ Valerianaceæ ———

——— *Rubiaceæ* Campanulaceæ **286 Compositæ** Calyceraceæ *Valerianaceæ* ———
——— *Dipsacaceæ* ———

10. The explanation of the dynamic system.

The arrangement of the families in the dynamic system given in the foregoing pages is somewhat comparable to that of numerous images of objects reflected by two mirrors standing at obtuse angles to each other, which objects lie between the two mirrors. This thought came to my mind, as I was reading the proofs of this paper; and I at once thought of myself as standing, as it were, just in front of the mirrors and looking at the innumerable images reflected in them.

Such an arrangement of families, as that in my system, should necessarily satisfy the following condition:—Provided that a family, say A, in the middle column of the system is compared with another family, say B, or other families, say B, C, ... , or in other words, provided the former A has the latter family or families, B, C, ... , at its side; in the case that family B or one of the families, B, C, D, ..., is in the middle column, then the latter family must infallibly has, in its turn, family A at its side. In order to accord with this condition, I have, while reading the proof, inserted in my system as many "reflected images" up to the limit of my knowledge, as all the families there mentioned should have. In the course of the reading, I have thought of a process by which we can test whether or not a system constructed as above satisfies this condition. Though I have been unable, in my present circumstances, to test my system by the process given, it will not be superfluous if I now describe this process as a supplement to my method of constructing a dynamic system.

As I have stated above, you first construct the system by placing the families of the framework in the middle vertical column in the same order as they originally appear in the same work, and by placing any other family or other families, which according to your knowledge you think is or are comparable with each family in the middle column, at the side of each of the families in the framework. Then you proceed to test whether or not the system thus constructed satisfies, as you expected, the necessary condition stated above, and at the same time, in passing, you perfect your system by adding any families that may have been omitted. In practice, you make a set of cards, on each of which is written a combination of each one, say A, of all the families in the

vertical column with a family or each one of all the families on the horizontal line on which the former family A lies, and at the same time you make another set of cards, on each of which is written in the reciprocal order the same combination as that just referred to above; for example, a set of such cards for Salicaceæ-Tamaricaceæ, ... etc., and another set of cards for Tamaricaceæ-Salicaceæ, ... etc. Take these two sets of cards together, and arrange them in any order you please, say in the alphabetical order*. If you find that all of your cards are each in a pair, then you will find that your system satisfies the condition proposed. If you find, on the other hand, any one card not in a pair, this shows you that the system does not satisfy the condition, so far as the two families mentioned on the card are concerned, and that, in either of the two horizontal lines leading to one of the two families in the middle column, one or the other of the two families is missing. In such a case, you examine which of the families is missing, and in which of the lines the omission occurs, and place the missing family on the line showing the omission. At the same time, you make two new cards, one with a combination of the two families, and the other with the same combination in the reciprocal order. Then, with either of the two new cards, you double the original card, which has until then been single, and with the other new card, you double the other card with the same combination in the reciprocal order, which card in such a case you will surely find unmistakablly single somewhere in your collection. If you do the same thing—adding families to your system, and cards to your collection—with all the single cards, then you will perfect your system, so far as the families in the latter are concerned. The above method which has been stated as to the families in the system will also hold good as to the series in the same.

In the present system, as we have seen, we have simply contemplated each relation of each two families separately. But, if we think of exhibiting the above relations not separately, but jointly, or relations of each group of three or more families, the system must become a very complicated one; and

* The best method is to give, before constructing the system, a number to each of the families of the framework — a number corresponding to each of their respective orders —, and then in the present case arrange the cards in the numerical order instead of the alphabetical order. This method is but partly followed in the present paper, as this idea has first occurred to me, when I was reading the proofs.

the families to be represented in it should be somewhat comparable to reflections on two mirrors showing images of objects lying between the mirrors placed at an acute angle, while the families in the present system are comparable to images on two mirrors placed at an obtuse angle[1]. Consequently, the ideal system showing all the relations of every two or every group of more than two of all the families, separately as well as jointly, successively as well as simultaneously, is something like a net of infinite extent with innumerable millions of crystal beads, each on a mesh of a different colour, and each reflecting the images of other beads, according to the illustration used above. (c. f. p. 104.)

Now, I come to an explanation of the system in particular. As the dynamic relations of the series have been fully discussed under the review of ENGLER's principles and his system in the foregoing pages, I shall here limit my explanation to the relations of the families. In so doing, however, in order to prevent needless repetition, the explanation of the relations of each two families or the literature bearing on the same subject is given in almost all cases only once, either under the heading of one of the latter two families, or under that of the series to which one of the latter two belongs. For example, the relation of families A–B, when it has been referred to or explained under family A, is omitted under family B. When the reader finds the latter is the case, as he is regarding family B in the explanation of the dynamic system, and desires to know the explanation of the relation of the families A–B, he is requested to refer to the heading of family A, using the index given at the end of this paper, and examine the explanations under the latter family where he will find the information desired or reference to it.

Subdivision **ANGIOSPERMÆ**

Class MONOCOTYLEDONEÆ

Series I. *Pandanales*

1 Typhaceæ[2]: These are related to the Sparganiaceæ in the axillary inflorescence and in the distichous leaves. At the same time, they show some resemblance to the Pandanaceæ in the structure of the male flowers.

1) Images of an object on two mirrors placed at an obtuse angle are two, while those on two mirrors at an acute angle become four, five, six,...., as the angle diminishes.

2) Nat. Pfl.-fam. II.—1, p. 185; GRÆBNER, P. —Typhaceæ, in das Pflanzenreich IV.—8, pp. 6-7.

2 Pandanaceæ[1]: In floral structure, most closely allied to the Sparganiaceæ; but in respect of the inflorescence, the connection is rather to be found in the Araceæ, Palmæ and Cyclanthaceæ.

3 Sparganiaceæ[2]: This family seems to bear some resemblance to the Typhaceæ; but in some respects, it approaches the Pandanaceæ rather than the Typhaceæ. Further, some points of similarity between the Sparganiaceæ and the Gramineæ are pointed out by CAMPBELL in his paper:—"On the similarity of the development of the embryo in the Gramineæ and Sparganiaceæ." But, the resemblance of the latter two families is opposed by GRÆBNER who insists upon of the incorporation of the Typhaceæ, Pandanaceæ, and Sparganiaceæ in the Pandanales.[3]

Series II. ***Helobiæ***

4 Potamogetonaceæ[4]: So far as the inflorescence of this family is concerned, its resemblance to the Araceæ is recognizable. On the other hand, with regard to the seeds and embryo, it is related to the Hydrocharitaceæ and Alismataceæ.

5 Najadaceæ[5]: A close relation to the Potamogetonaceæ is found in the large exalbuminous seeds. In one respect, it is somewhat allied to the Scheuchzeriaceæ; but in another, it bears some resemblance to the Ceratophyllaceæ. As far as its general vegetative structures are concerned, *Najas* strongly resembles several submerged genera of the Hydrocharitaceæ with slender branching stems, and crowded sessile leaves which are often finely toothed at the margin.[6]

6 Aponogetonaceæ[7]: Some genera of this family approach the Juncaginaceæ, Potamogetonaceæ and Alismataceæ in having free carpels.

7 Scheuchzeriaceæ[8] (=Juncaginaceæ): The intimate relationship of this small family to the Alismataceæ and to the Potamogetonaceæ is incontestable. But the present family can not satisfactorily be included in either of the latter two.

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1) l. c. II.—1, 190, and II.—3, p. 98.
2) l. c. II.—1, p. 193.
3) Nat. Pfl.-fam. Nachtr. III. p. 8.
4) Nat. Pfl.-fam. II.—1, p. 201, and 223.
5) Nat. Pfl.-fam. II.—1, p. 217, and III.—2, p. 12.
6) RENDLE, A. B.—Najadaceæ, in das Pflanzenreich IV. 12. p. 6.
7) l. c. II.—1, 221.
8) l. c. II.—1, p. 223.

8 Alismataceæ[1]: Certainly related to the Butomaceæ and Juncaginaceæ. But, so far as habit and floral structure are concerned, it can not be denied that a close affinity exists between the Alismataceæ and the Ranunculaceæ. The Triuridaceæ resemble the Alismataceæ in having numerous free carpels.

9 Butomaceæ[2]: Related to the Alismataceæ, Triuridaceæ and Hydrocharitaceæ.

10 Hydrocharitaceæ[3]: If we lay great stress upon the inferior position of the ovary, the family is comparable with the Bromeliaceæ, Amaryllidaceæ, Iridaceæ, Burmanniaceæ and Orchidaceæ. If we think otherwise, the case is altogether different. Thus, with respect to the structure of seeds and pollen, it (such as *Halophila*) bears a close relation to some genera of the Potamogetonaceæ; but, in view of the axillary position of flowers, the perianth, and the parietal placenta, it is closely allied to the Mayacaceæ.[4]

Series III. ***Triuridales***

11 Triuridaceæ[5]: This family is to some extent comparable with the Orchidaceæ and Burmanniaceæ in its habit; and also to the Alismataceæ and Butomaceæ in the many free carpels; but in other respects, as is suggested by some authors, it is rather related to the Dicotyledons.

Series IV. ***Glumifloræ***

12 Gramineæ[6]: Certain affinity of the family with the Cyperaceæ is evidently conceivable. It is also comparable with the Juncaceæ[7], and is a well marked family. As is generally the case with well-defined families, the classification of the species or genera of the Gramineæ is a difficult task. There is no good character which can be regarded as a distinguishing trait for a tribe or subtribe. It is rather the combination of characters that can be taken for the latter. No tribe nor large genus in this family is defined with any acuracy. All members are related to one another as if they were a network. The relative positions of tribes, genera and species are, therefore,

1) l. c. II.—1, p. 229.
2) Nat. Pfl.-fam. II.—1, p. 233.
3) l. c. II.—1, pp. 246 and 201.
4) l. c. II.—4, p. 18.
5) l. c. II.—1, and 237.
6) Nat. Pfl.-fam. II.—2, p. 16.
7) Jeffrey, E. C.—l. c. p. 413.

indeterminable in one way, but are changeable according to their natural relations.

13 Cyperaceæ[1]: This family is somewhat related to the Gramineæ and to the Juncaceæ in habit. Also to the Restionaceæ, Centrolepidaceæ and Eriocaulaceæ in several different characters respectively.

Series V. ***Principes***

14 Palmæ[2]: With *Phytelephas* and *Nipa* as its intermediate members, this family approaches the Pandanaceæ. It also to some extent resembles the Cyclanthaceæ in its leaves.

Series VI. ***Synanthæ***

15 Cyclanthaceæ[3]: So far as the vegetative organs are concerned, this family is closely related to the Palmæ; but not so closely to the Araceæ in this respect. On the other hand, if we take female flowers as a criterion, then it departs widely from the Palmæ, while coming near the Araceæ and the Pandanaceæ. As to its male flowers, however, it is somewhat comparable with the Palmæ. But, the anatomical structure of certain Cylanthaceæ is rather that of the Araceæ[4].

Series VII. ***Spathifloræ***

16 Araceæ: The connection of the family is found to be with the Taccaceæ[5], Potamogetonaceæ[6], Cyclanthaceæ[7], and Lemnaceæ[8] in this or that respect. It is also comparable with the Typhaceæ, Pandanaceæ and Sparganiaceæ in the possession of a spatha and therefore it was formerly incorporated with them to form a group of the Spathifloræ[9].

17 Lemnaceæ[8]: Their relation to the Araceæ is incontestable.

Series VIII. ***Farinosæ***

18 Fragellariaceæ[10]: The 5-whorled flowers with homochlamydeous perianth suggest its relation-ship to the Juncaceæ.

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1) Nat. Pfl.-fam. II.—2, p. 104.
2) l. c. II.—3, p. 25.
3) l. c. II.—3, p. 98.
4) Jeffrey, E. C.—l. c. p. 413.
5) Nat. Pfl.-fam. II.—5, p. 129.
6) l. c. II.—1, p. 201.
7) l. c. II.—2, p. 98.
8) Rendle.—A. B, The classification of flowering plants, I. p. 382.
9) Græbner, P.—Spargamaceæ in das Pflanzenreich. IV.—10, p. 7.
10) l. c. II.—4, p. 1.

19 Restionaceæ[1]: Very probably connection is to be found in the Glumifloræ.

20 Centrolepidaceæ[2]: Closely related to the Eriocaulaceæ and to the Restionaceæ. It resembles the former family in *Juncella* with its capitate flowers, while it approaches the latter in *Gaimardia* with its di-merous flowers.

21 Mayacaceæ[3]: That a close relation exists between the Mayacaceæ and Hydrocharitaceæ can not be denied, if the agreement of the two families in their axillary flowers, in the perianth, and in the parietal placenta is to be regarded as a matter of importance.

22 Xyridaceæ: The relation of this to other families is as yet unknown to us.

23 Eriocaulaceæ[4]: Related to the Restionaceæ, Centrolepidaceæ, Mayacaceæ and Xyridaceæ through the structure of the gynæceum and stamens.

24 Thurniaceæ: As above.

25 Rapateaceæ[5]: This family undoubtedly is closely related to the Xyridaceæ, Eriocaulaceæ and other families; but differs from all of them in having atropous ovules.

26 Bromeliaceæ[6]: These are certainly related to the several families of the Farinosæ, such as the Commelinaceæ, Rapateaceæ, Mayacaceæ and Flagellariaceæ, in their general characters. But in other respects, they are closely connected with the Liliaceæ and Amaryllidaceæ of the Liliifloræ. When we take the family's heterochlamydeous character into account, its place is near the Scitamineæ, and the Liliifloræ. In the position of the ovary on the other hand, some of the Bromeliaceæ are related to the Orchidaceæ, to the Hydrocharitaceæ and to the Scitaminaceæ.

27 Commelinaceæ: As above

28 Pontederiaceæ[7]: This family is somewhat related to the Liliaceæ in floral structure.

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1) Nat. Pfl.-fam. II.—4, p. 15. 2) Nat. Pfl.-fam. II.—4, p. 15.
3) l. c. II.—4, p. 18.
4) Ruhland, W.—Eriocaulaceæ in das Pflanzenreich IV.—30, p. 23.
5) l. c. II.—4, p. 30.
6) Nat. Pfl.-fam. II.—4, p. 40. 7) l. c. II.—4, p. 72.

29 Cyanastraceæ[1]: Related to the Hæmodoraceæ and Potentedriaceæ.

30 Philydraceæ[2]: Related to the Pontederiaceæ and Commelinaceæ.

Series IX. ***Liliifloræ***

31 Juncaceæ[3]: This family is somewhat near the Gramineæ and Cyperaceæ in the vegetative organs; but, is closely related to the Liliaceæ in its floral structure. It also resembles the Restionaceæ.

32 Stemonaceæ: These are closely related to the Liliaceæ through an intermediate form of *Majanthemum*, a genus of the latter family.

33 Liliaceæ[4]: Closely resemble the Juncaceæ, through the Lomandreæ which have the characteristic perianth of the latter family. They also come quite close to the Amaryllidaceæ.

34 Hæmodoraceæ[5]: Closely related to the Liliaceæ and Amaryllidaceæ and also to the Iridaceæ in the single staminal whorl. All the plants in my index under this family belong to the Liliaceæ, according to the determination of the two families given in ENGLER'S 'Pflanzenfamilien'.

35 Amaryllidaceæ[6]: This family is closely connected with the Liliaceæ, as can be seen from several facts e. g. that the Asphodeloideæ, a tribe of the latter family, have a spirally arranged inflorescence like the Amaryllidoideæ, that *Similax* (Liliaceæ) has many stamens like *Gethyllis* (Amaryllidaceæ), and that the Gilliesieæ (Liliæ) have a paracorolla, which is the characteristic of the Narcisseæ (Amaryllidaceæ). Besides, the Amaryllidaceæ bear some resemblance to the Hæmodoraceæ, Iridaceæ, Taccaceæ and Dioscoreaceæ. They also approach the Velloziaceæ, as can be seen in a comparison of *Gethyllis* and *Vellozia*.

36 Velloziaceæ[7]: If importance is attached to such characters as the placenta and the numerous stamens, it should stand as a special family. But, if little or no notice is taken of the said characters, it should be included in the Amaryllidaceæ or in the Hæmodoraceæ as may seem best.

37 Taccaceæ[8]: These are related to the Amaryllidaceæ, especially to the Hypoxidoideæ of the latter family, in the one-celled ovary. Besides, a rather

1) Nat. Pfl.-fam. Nacht. III. p. 43.
2) l. c. II.—4, p. 75.
3) l. c. II.—5, p. 4.
4) l. c. II.—5, p. 17.
5) Nat. Pfl.-fam. II.—5, p. 94.
6) l. c. II.—5, p. 101.
7) Nat. Pfl.-fam. II.—5, p. 126.
8) l. c. II.—5, p. 129.

remote relation is to be found between the Taccaceæ and the Iridaceæ in the form of the stigmata, on the one hand, and on the other, between the former family and the Dioscoreaceæ in the undivided ovary. Moreover, there exists some resemblance in the Taccaceæ and Burmanniaceæ.

38 Dioscoreaceæ[1]: Very clearly related to the Liliaceæ, especially to the Smilacoideæ of the latter family. Another connection is to be found between this family and the Taccaceæ or Amaryllidaceæ.

39 Iridaceæ[2]: These resemble the Hæmodoraceæ in the single whorl of the andrœceum, though the latter are represented by the outer whorl in the Iridaceæ, while by the inner whorl in the Hæmodoraceæ. The Moræeæ of the Iridaceæ approach the Taccaceæ in the shape of their stigmata.

Series X. ***Scitamineæ***

40 Musaceæ[3]: The coincidence in the floral structure in the Musaceæ and Orchidaceæ is the most precise conceivable in the comparison of orchidaceous flowers and *Lowia* and *Orchidantha* both of which show their lips directed downwards by resupination.

41 Zingiberaceæ: As above.

42 Cannaceæ: As above.

43 Marantaceæ[4]: These are nearest the Cannaceæ; while the latter are related to the Zingiberaceæ. The four families of the Scitamineæ are connected at one point or another.

Series XI. ***Microspermæ***

44 Burmanniaceæ[5]: Some relations seem to exist between this family and the Orchidaceæ, and also between it and the Amaryllidaceæ.

45 Orchidaceæ[6]: This family is near the Burmanniaceæ and the Triuridaceæ. It agrees to some extent with the Musaceæ, Zingiberaceæ and Marantaceæ in its imperfect staminal whorls. The diagram of *Musa* is in accordance with that of *Arundina pentandra*.

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1) Nat. Pfl.-fam. II.—5, p. 132.　　2) l. c. II.—5, p. 141.
3) Schumann, K. O. — Musaceæ, in das Pflanzenreich, IV.—45, pp. 11-12, et p. 41, Fig. 10.
4) Nat. Pfl.-fam. II.-6, p. 38.　　5) l. c. II.—6, p. 46.
6) l. c. II.—6, p. 75.

Class DICOTYLEDONEÆ

Subclass **Archichlamydeæ**

Series XII. ***Verticillatæ***

46 Casuarinaceæ[1]: So far as the anatomical characters of the family are concerned, it is closely related to the Gnetaceæ; but if we lay much stress upon the character of chalazogamy, it should be connected with the Juglandaceæ, the Betulaceæ, certain Urticaceæ[2] and the Ericaceæ[3].

Series XIII. ***Piperales***

47 Saururaceæ[4]: Related to the Piperaceæ.

48 Piperaceæ: Allied to the Saururaceæ.

49 Chloranthaceæ: Related to the Piperaceæ.

50 Lacistemaceæ[5]: Near the Piperaceæ.

Series XIV. ***Salicales***

51 Salicaceæ[6]: When the resemblance of perianth and inflorescence is taken into account, this family is to some extent comparable with the Betulaceæ, and the Myricaceæ. On the other hand, when we attach importance to the structure of seeds and fruit, we should regard the Salicaceæ as a family closely related to the Tamaricaceæ. Moreover, their relation to the Batidaceæ is to be found in the presence of the dimerous gynæceum.

Series XV. ***Garryales***

52 Garryaceæ: Their relation to other families is not yet established.

Series XVI. ***Myricales***

53 Myricaceæ: Related to the Juglandacæ, Salicaceæ and Betulaceæ.

Series XVII. ***Balnopsidales***

54 Balanopsidaceæ[7]: They are related to the Euphorbiaceæ in the character of the ovules and approach the Fagaceæ in the involucre of the female flowers.

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1) Nat. Pfl.-fam. Nacht. III. p. 92.
2) JEFFREY, E. C.—The anatomy of Woody Plants (Chicago, 1917) p. 376.
3) JEFFREY, E. C.—l. c. p. 385.
4) Nat. Pfl.-fam. III.—1, p. 2.
5) l. c. III.—1, p. 15.
6) l. c. III.—1, p. 35.
7) Nat. Pfl.-fam. Nacht. I. p. 116.

Series XVIII. *Leitneriales*

55 Leitneriaceæ[1]: This family may be in some degree connected with the Hamamelidaceæ by the presence of the resin-ducts in the medulla-sheath.

Series XIX. *Juglandales*

56 Juglandaceæ[2]: Closely related to the Julianiaceæ and to the Myricaceæ. Also related to the Fagaceæ, in the arrangement of the flowers. Further, the family is comparable with the Anacardiaceæ in the exstipulate imparipinnate leaves.

Series XX. *Batidales*

57 Batidaceæ[3]: Related to the Amarantaceæ and Phytolaccaceæ, and also to the Chenopodiaceæ.

Series XXI. *Julianiales*

58 Julianiaceæ[4]: See statement under the Julianiales in the review of and critical remarks on ENGLER's principles and his system in the present paper.

Series XXII. *Fagales*

59 Betulaceæ[5]: Closely related to the Fagaceæ in the inflorescence and in the parietal ovules. Also to the Myricaceæ and Juglandaceæ.

60 Fagaceæ[6]: Intimately connected with the Betulaceæ, also with the Myricaceæ, Juglandaceæ and Julianiaceæ.

Series XXIII. *Urticales*

61 Ulmaceæ: This and the two following families are closely interrelated.

62 Moraceæ[7]: As above.

63 Urticaceæ: As above.

Series XXIV. *Proteales*

64 Proteaceæ[8]: Somewhat approach the Thymelæaceæ and Lauraceæ.

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1) Nat. Pfl.-fam. Nacht. I. p. 117. 2) Nat. Pfl.-fam. III.—1, p. 22.
3) Nat. Pfl.-fam. III.—1, a, p. 120; Nachtr. III. p. 105.
4) HEMSLEY, W. B.—On the Julianiaceæ, in Phil. Trans. Roy. Soc. Lond. Vol. CXCIX., (B. 253), pp. 190–193.
5) Nat. Pfl.-fam. III.—1, p. 41. 6) l. c. III.—1, p. 52.
7) l. c. III.—1, p. 69.
8) BENTH.-HOOKER, Genera Plantarum. III. p. 165.

Series XXV. ***Santalales***

65 Myzodendraceæ[1]: Near the Santalaceæ and the Loranthaceæ.

66 Santalaceæ:[2] Closely related to the Loranthaceæ in many common characters and especially in the dwarfed ovules, in the manner of fertilization and in the development of the embryo. It is also near the Myzodendraceæ in the structure of the ovary and in the embryo which is partly imbedded in the albumen. Moreover, it is found to be connected with the Grubbiaceæ and also with the Olacaceæ. So far as morphological features are concerned, its relation to the Coniferæ is undeniable, as can be seen in a comparison of the Antholobeæ and the Gnetaceæ.

67 Opiliaceæ: ....

68 Grubbiaceæ[3]: This family is somewhat related to the Santalaceæ in the structure of the ovule; but it comes nearer to the Olacaceæ than to the Santalaceæ in the structure of the ovary. Further, some connection seems to exist between the Grubbiaceæ and the Hamamelidaceæ, as can be seen in the agreement of *Grubbia* and the latter family in their anatomical characters.

69 Olacaceæ[4]: Viewed from the position of the ovules, the family comes near the Santalaceæ; but in the presence and arrangement of its sepals and petals, it is close to the Icacinaceæ. The limits of the family vary with the view taken of it. If we attach great importance to such a character as the integment of the ovules, then the family should be broken up and reorganized into many families, as has been done by VAN TIEGHEM.

70 Octoknemataceæ:—

71 Loranthaceæ[5]: If the calyculus passes for a reduced calyx, then the family comes into intimate relation with the Vitaceæ, and in consequence, also with the Cornaceæ and Araliaceæ. If we regard the organ in question as a mere swelling on the apex of a perianth tube, then the Loranthaceæ should be placed near the Proteaceæ and Santalaceæ.

72 Balanophoraceæ[6]: The sphere of this family varies with the criteria. If we lay much stress upon the arrangement of the andrœceum, it should be

1) Nat. Pfl.-fam. III.—1, p. 202. 2) Nat. Pfl.-fam. III.—1, p. 211.
3) l. c. III.—1, p. 229.
4) Nat. Pfl.-fam. III.—1, p. 233; Nacht. I. p. 144.
5) Nat. Pfl.-fam. III.—1, p. 176. 6) l. c. III.—1, p. 249.

broken up into many families. But, if we put the latter character aside, it will stand as one family; for the female flowers and ovaries, different as they are in different genera, show transitions so gradual that they may be connected one with another. Some genera of this family have flowers which are comparable with those of the Halorrhagaceæ. But the greater number of the genera suggest their connection with the Santalaceæ.

Series XXVI. ***Aristolochiales***

73 Aristolochiaceæ[1]: If we set store by the presence or absence of a reduced calyx, then *Asarum* and *Aristolochia* should not be incorporated in one and the same family. *Aristolochia* should come close to the Tubifloræ. But in other respects, the two genera are very closely related. In the serum-reaction the family is related with the Nymphæaceæ and the Anonaceæ[2].

74 Rafflesiaceæ: Near the Aristolochiaceæ in the simple perianth and in the central genital column. HALLIER states that this family together with the Hydnoraceæ may be kin of the Nepenthaceæ, Anonaceæ and Nymphæaceæ in the fleshy perianth, column, large peltate stigmata, semi-inferior ovary, trimerous perigon, and in the perisperm[3].

75 Hydnoraceæ[4]: As above.

Series XXVII. ***Polygonales***

76 Polygonaceæ[5]: Near the Amarantaceæ.

Series XXVIII. ***Centrospermæ***

77 Chenopodiaceæ[6]: Connected with the Amarantaceæ, Phytolaccaceæ, Portulacaceæ, Aizoaceæ, Caryophyllaceæ and Nyctaginaceæ—in each case by a different character. As to the genera of this family, they do not stand in a serial relation, and consequently it is altogether impossible to arrange them according to their lineage. The same is true of all families and especially of the larger ones such as the Gramineæ, Cruciferæ or Rosaceæ. VOLKEN'S opinion as to the classification of the Chenopodiaceæ demands consideration. He says: "Ob man z. B. die Polycnemeæ zu den Amarantaceæ oder den

1) Nat. Pfl.-fam. p. III.—1, p. 270. 2) MEZ, C. and LANGE, L.—l. c.
3) SOMLS-LAUBACH,—Rafflesiaceæ, in das Pflanzenreich, IV.—75, p. 7.
4) l. c. III.—1, p. 285. 5) Nat. Pfl.-fam. III.—1, a, p. 8.
6) l. c. III.—1, a, p. 51.

Chenopodiaceæ rechnen, oder aber eine eigene diesen coordinierte Familie aus ihnen machen will, ist meiner Meinung nach durchaus conventionell. In der Idee ist es ein Leichtes, ihren 'Bauplan' aus dem jeder dieser beiden Familien 'abzuleiten', für die Berechtigung des einen oder andern aber fehlen jegliche positive Unterlagen. Dasselbe gilt, wenn man die einzelnen Unterabteilungen der Chenopodiaceæ vergleichend prüft und sich fragt, welche von ihnen ist denn nun etwa der Stamm, von dem die anderen Auszweigungen darstellen? BUNGE meint, wenn man von den unvollkommensten zu den vollkommenen fortschreite, habe man sie so anzuordnen: Salicornieæ, Corispermeæ, Chenopodiaæ, Camphorosmeæ, Atripliceæ, Suædeæ, Sodeæ, Anabaseæ. Was ist aber hier das Vollkommene, was das Unvollkommene? Mir fehlt jeder Maßstab dafür. Paläontologische Funde, die darüber entscheiden könnten, mangeln durchaus." Howsoever perfect and satisfactory be the paleontological data, yet when we take mutation, crossing and other possibilities into consideration as causes of species variation, we are quite convinced that it is altogether impossible to establish the affiliation between species and species by studying their constitutional characters.

78 Amarantaceæ[1]: Closely related to the Chenopodiaceæ, and Phytolaccaceæ. The family is also allied to the Portulacaceæ, Aizoaceæ and Caryophyllaceæ.

79 Nyctaginaceæ[2]: Close relation exists between the Phytolaccaceæ and the Nyctaginaceæ; while by *Cryptocarpus, Reinchenbachia* and *Colignonia* of the latter family, they are connected with the Chenopodiaceæ.

80 Cynocrambaceæ[3]: This family bears some relations to the Urticaceæ, Chenopodiaceæ, Phytolaccaceæ, Begoniaceæ, Santalaceæ, Monimiaceæ and Caryophyllaceæ according to different views.

81 Phytolaccaceæ[4]: Very near the Aizoaceæ, Nyctaginaceæ and to the Chenopodiaceæ.

82 Aizoaceæ[5]: Near the Portulacaceæ and Caryophyllaceæ. The family is also allied to the Phytolaccaceæ in its typical apetalous flower. At any

1) Nat. Pfl.-fam. III.—1, a, p. 96.
2) l. c. III.—1, b, p. 21.
3) l. c. III.—1, a, p. 123.
4) Nat. Pfl.-fam. III.—1, b, p. 5.
5) l. c. III.—1, b, p. 38.

rate, the very close relation of the Aizoaceæ to the Cactaceæ is incontestable, as can be seen in the floral diagram of *Mesembrianthemum* and *Opuntia*.

83 Portulacaceæ[1]: Closely related to the Caryophyllaceæ in the structure of its ovaries and seeds; also allied to the Aizoaceæ through the semi-inferior ovary of *Portulaca* and in numerous petals and sepals of *Lewisia* (both of the Portulacaceæ).

84 Basellaceæ[2]: Near the Portulacaceæ.

85 Caryophyllaceæ: Related to the Amarantaceæ, Chenopodiaceæ, Phytolaccaceæ, Portulacaceæ, Nyctaginaceæ, Aizoaceæ, in the structure of the placenta, ovules and seeds.

Series XXIX. ***Ranales***

86 Nymphæaceæ[3]: The close connections of this family with the Berberidaceæ are seen in the agreement of *Nelumbo, Cabomba* of the Nymphæaceæ, and *Podophyllum, Jeffersonia* and *Diphylleia* of the Berberidaceæ, in the arillus, in the presence of vasculalar bundles in the medulla, in the distinct floral elements. Also related to some of the Papaveraceæ in the attachment of the ovules to the wall of the ovary and in the laticiferous vessels. Furthur, it agrees with the Ranunculaceæ in the free floral elements, in the follicles, in the small flowers and in the divided submerged leaves of the Cabombeæ.

87 Ceratophyllaceæ[4]: This family is undoubtedly referable to the Ranales in the polymerous segments of the perianth, in the numerous stamens, in the convex receptacle, and in the free carpels.

88 Trochodendraceæ[5]: In the absence of vessels in the xylem, this family shows some connections with the Coniferæ. It is certainly comparable with the Magnoliaceæ in the spiral arrangement of the floral elements and in the structure of its seeds. But, on the other hand, if the separate carpels, perigynous insertion and the small embryo are taken into consideration, it should be brought close to the Saxifragaceæ.

89 Cercidiphyllaceæ[6]: Nearly as above.

90 Ranunculaceæ[7]: Related to the Magnoliaceæ, Anonaceæ and

1) l. c. III.—1, b, p. 52.
2) Nat. Pfl.-fam. III.—1, b, p. 67.
3) l. c. III.—2, p. 3.
4) Nat. Pfl.-fam. III.—2, p. 12.
5) l. c. III.—2, p. 23.
6) l. c. Nactr. III. p. 111.
7) Nat. Pfl.-fam. III.—2, p. 54.

phæaceæ in the undetermined number of the stamens, in the separate carpels, and in the spiral arrangement of floral elements, this family is also near the Berberidaceæ in the integments of its ovules. Further, it comes quite close to the Rosaceæ. Moreover, very striking resemblance is to be found in the Alismataceæ and Ranunculaceæ in the floral structure. Finally the Ranunculaceæ is somewhat related to the Leguminosæ in the serum-reaction[1].

91 Lardizabalaceæ[2]: This family is related to the Menispermaceæ on one hand, but on the other, to the Berberidaceæ. To the former, it approaches in the volubile habit, in the palmate leaves and in the diclinous flowers; and with the latter it agrees in the number of its floral elements.

92 Berberidaceæ[3]: Near the Ranunculaceæ on one hand; but on the other, near the Papaveraceæ and Fumariaceæ; also closely related to the Lardizabalaceæ.

93 Menispermaceæ[4]: This family is related to the Lardizabalaceæ in its floral structure, and in its climbing habit; but on the other hand, it bears some resemblance to the Sabiaceæ, in the absence of albumen, in the curved embryo, reniform fruit and apocarpous gynæceum. The resemblance between the Menispermaceæ and the Dioscoreaceæ in the structure of their male flowers is very striking. Still more remarkable is the coincidence of the Menispermaceæ and the Euphorbiaceæ as seen in the several genera of the two families[5].

94 Magnoliaceæ[6]: The absence of the vessels in the xylem in some genera (*Drimys* and *Zygogynum*) of the family, shows some connection with the Coniferæ and Trochodendraceæ. But, the agreement in the spiral arrangement of the floral elements, in the shape of the pollen-grains, in the separate carpels, in the oil-tube in the parenchyma, in the Magnoliaceæ, Anonaceæ and Calycanthaceæ, shows that they are closely related.

95 Calycanthaceæ[7]: This is certainly related to the Magnoliaceæ and Anonaceæ, in the structure of the flowers and "Ölgehalt." It also resembles in some degree the Monimiaceæ.

96 Lactoridaceæ[8]: This family is closely connected with the Magnolia-

1) Mez, C. and Lange, L.—l. c.
2) l. c. III.—2, p. 69.
3) l. c. III.—2, p. 74.
4) Nat. Pfl.-fam. III.—2, p. 82.
5) Diels, L.—Menispermaceæ, in das Pflanzenreich, IV.—94 p. 41.
6) l. c. III.—2, p. 15 and Nachtr. I. p. 158.
7) l. c. III.—2, p. 92.
8) Nat. Pfl.-fam. III.—2, p. 20.

ceæ, especially with the *Dryms* of the latter family.

97 Anonaceæ[1]: Relationship with the Magnoliaceæ as seen in the floral structure and in the presence of the "Ölgehalt" is very clear. It somewhat agrees with the Ebenaceæ in the rimose albumen and in the trimerous flowers (especially with *Maba*). It is also comparable to some extent with the Ancistrocladaceæ; and also to the Aristolochiaceæ[2].

98 Eupomatiaceæ: Closely related to the Anonaceæ.

99 Myristicaceæ[3]: This family is certainly comparable with the Anonaceæ in its general character. But in the presence of oil-cells in the cortex, medulla and leaves, and in the connate stamens, it rather approaches the Winteranaceæ.

100 Gomortegaceæ[4]: Related to the Lauraceæ and Monimiaceæ.

101 Monimiaceæ[5]: Closely related to the Calycanthaceæ and to the Lauraceæ.

102 Lauraceæ[6]: The agreement in the valvate anthers, in the one-celled ovary, in the solitary hanging anatropous ovules, in the presence of the oil-cells, of this family and Monimiaceæ shows their strong affinity. But regarding the circular arrangement of their floral elements and the syncarpous gynæceum, the Lauraceæ very closely approach the Thymelæaceæ.

103 Hernandiaceæ[7]: Certainly this family is closely related to the Lauraceæ in the secretory cells, in the floral structure, in the fruit, in the identical characters of the anthers and in the gynæceum.

Series XXX. ***Rhœadales***

104 Papaveraceæ[8]: Most closely related to the Capparidaceæ, and after that, to the Cruciferæ, in the essential structure of flowers and fruit. The Tovariaceæ stand half-way between the Capparidaceæ and the Papaveraceæ. The connection of the latter with the Berberidaceæ on the other hand is seen in the di- or trimerous flowers and in the seeds of both families. HALLIER

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1) Nat. Pfl.-fam. III.—2, p. 27.
2) MEZ, C. and LANGE, L.—l. c.
3) l. c. III.—2, p. 41.
4) Nat. Pfl.-fam. Nacht. I. p. 173.
5) l. c. III.—2, p. 97.
6) l. c. III.—2, p. 111.
7) l. c. III.—2, p. 128.
8) Nat. Pfl.-fam. III.—2, p. 136.

insists that the relationship of the Papaveraceæ and the Ranunculaceæ is shown by a comparison of *Corydalis* with *Leptopyrum*, and *Platystemon* with *Ranunculus*[1].

105 Capparidaceæ[2]: Closely related to the Cruciferæ.

106 Kœberliniaceæ[3]: ENGLER formerly placed this family in the Parietales, but later on he brought it to the Rhœadales and united it with the Capparidaceæ. I put it here for the sake of convenience, next to the Capparidaceæ. ZUCCARINI and ENDLICHER refer it to the Pittosporaceæ on account of its many-seeded placentas. Asa Gray and BENTHAM-HOOKER ascribe it to the Rutaceæ of the Geraniales; ENGLER, however, does not regarded this family as referable to the same series. The Kœberliniaceæ are comparable with the Saxifragaceæ or with the Parietales, in the placenta with numerous polyseriate ovules. They are near the Bixaceæ in their deciduous sepals. The existence of some connections between the flowers of this family and those of the Rhœadales is almost undeniable.

107 Cruciferæ[4]: In floral structure, this family is directly related to the Papaveraceæ, and after that, to the Capparidaceæ.

108 Tovariaceæ[5]: Somewhat near the Phytolaccaceæ (BENTH.-HOOKER). But, on the other hand, the family stands between the Papaveraceæ and the Capparidaceæ (EICHLER). It approaches the Capparidaceæ in the structure of its seeds and in its habit.

109 Resedaceæ[6]: Near the Cruciferæ and the Capparidaceæ. With the latter, the family agrees in the parietal placenta, in the gynophore and in the zygomorphous flowers.

110 Moringaceæ[7]: DALZELL compares this family with the Bignoniaceæ, while it is brought near the Violaceæ by LINDLEY and HOOKER. GRISEBACH and BAILLON bring it into comparison with some of the Rhœadineæ, especially with the Capparidaceæ; but ENDLICHER, DECAISNE and BENTHAM place it beside the Leguminosæ or even assign it to the latter family. Other botanists

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1) FEDDE, F.—Papaveraceæ, in das Pflanzenreich IV.—104, p. 74.
2) l. c. III.—2, p. 220.
3) l. c. III.—6, p. 321.
4) Nat. Pfl.-fam. III.—2, p. 152.
5) l. c. III.—2, p. 207.
6) Nat. Pfl.-fam. III.—2, p. 239.
7) l. c. III.—2, p. 244.

insist upon the existence of a relationship between the Moringaceæ and the Geraniales. PAX considers that it is probably best to regard the family as a middle member between the Rhœadineæ and the Leguminosæ.

Series XXXI. *Sarraceniales*

111 Sarraceniaceæ[1]: Clearly related to the Droseraceæ in floral structure. The family is placed near the Papaveraceæ by BENTHAM and HOOKER on account of the staminal cycles and styles. On the other hand its relation to the Nymphæaceæ is incontestable, as can be seen in the numerous stamens, in the insertion of the leaves on the stem, in the one-flowered scape and in the spiral arrangement of the sepals. But, MACFARLANE[2] inclines to look for even closer natural affinity with the Cistifloræ than with the Papaveraceæ and Nymphæaceæ.

112 Nepenthaceæ[3]: R. BROWN, BRONGNIART, LINK and ENDLICHER put this family close to the Cytineæ and Aristolochiaceæ, which agree with the Nepenthaceæ in the perianth, in the entrorse anthers, in the many-seeded capsules and probably in the stigmata. LINDLEY, GRISEBACH and EICHLER place it near the Droseraceæ and Sarraceniaceæ in consideration of the fruit and seeds. The Nepenthaceæ and Sarraceniaceæ have considerable affinities with the Droseraceæ, and all of these seem to stand in a position intermediate between the Papaveraceæ and the Cistaceæ[4].

113 Droseraceæ[5]: As far as the hypogynous insertion and the parietal placenta are concerned, the family is comparable with the Cistaceæ and Violaceæ; but in the perigynous insertion and in the locular ovary (of some species of the family) it comes rather close to the Saxifragaceæ.

Series XXXII. *Rosales*

114 Podostemonaceæ[6]: It seems reasonable to believe that the family is related to the Saxifragaceæ, as there is agreement in the hypogynous and

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1) Nat. Pfl.-fam. III.—2, p. 251.

2) MACFARLANE, J. M.—Sarraceniaceæ, in das Pflanzenreich, IV.—110, p. 241.

3) l. c. III.—2, p. 259.

4) MACFARLANE, J. M.—Nepenthaceæ, in das Pflanzenreich, IV.—111, p. 26.

5) Nat. Pfl.-fam. III.—2, p. 267, and DIELS, L.—Droseraceæ, in das Pflanzenreich, IV.—112, p. 50-52.

6) l. c. III.—2, a, p. 16.

dimerous ovary, in the numerous seeds, in the free styles and in the anatropous ovules. But in other respects, it is comparable with the Caryophyllaceæ.

115 Hydrostachyaceæ: Related to the Podostemonaceæ.

116 Crassulaceæ[1]: This family is somewhat related to the Elatinaceæ the isomerous flowers and in the habit, as can be seen in *Tillæa aquatica* L. in which is at present referred to the Crassulaceæ, but is closely related to *Elatine*. In general, it is connected with the Saxifragaceæ more closely than with any other family.

117 Cephalotaceæ[2]: Near the Saxifragaceæ and Crassulaceæ.

118 Saxifragaceæ[3]: Certainly quite close to the Crassulaceæ and Cunoniaceæ, and then, to the Hamamelidaceæ and Rosaceæ. But, the family has some relation to the Trochodendraceæ in the separate carpels, in the perigynous insertion and in the small embryo; then, to the Kœberliniaceæ in the placenta with numerous seeds in many series. Further, the resemblance of this family to the Begoniaceæ can not be denied, as there are agreements in both families, in the perigynous insertion, in the parietal placenta, in the small seeds, in the dehiscence of the fruit, and in the shape of the leaves.

119 Pittosporaceæ[4]: R. Brown compares this family with the Celastraceæ and Rhamnaceæ. De Candolle places it between the Polygalaceæ and the Caryophyllaceæ, while Richard and Schnitzlein insist upon the existence of a relation between it and the Caryophyllaceæ. Endlicher and Eichler consider it better to bring it back again near the Celastraceæ; but Bentham and Hooker class it with the Polygalaceæ, Tremandraceæ and Vochysiaceæ in the Polygalineæ. Van Tieghem compares it with the Umbelliferæ and Araliaceæ in the peculiar distribution of resin-ducts in the root and in the formation of lateral roots. Baillon says that there is no absolute difference between the floral structure of the Pittosporaceæ and that of the Saxifragaceæ. Some relations seem to exist between the Pittosporaceæ and the Hamamelidaceæ in the presence of resin-ducts.

120 Brunelliaceæ[5]: Somewhat near the Cephalotaceæ, this family is

1) Nat. Pfl.-fam. III.—2, a, p. 28.
2) l. c. III.—2, a, p. 40.
3) l. c. III.—2, a, p. 45.
4) Nat. Pfl.-fam. III.—2, a, p. 108.
5) Nat. Pfl.-fam. Nacht. p. 184.

also closely related to the Cunoniaceæ in the verticillate stipulate leaves, and in the presence of the inner and outer layers of the pericarps.

121 Cunoniaceæ[1]: These come close to the Saxifragaceæ. But, the regular two-seriate seeds on the placenta and the tendency of the carpels to grow together, bring the Cunoniaceæ near the Crassulaceæ.

122 Myrothamnaceæ[2]: This family is closely allied to the Cunoniaceæ in habit, in the opposite stipulate leaves, in the long, erect dense terminal flowered spike, in the bracts and bracteoles, in the fruit, and in the staminodes.

123 Bruniaceæ[3]: These approach very close to the Saxifragaceæ in anatomy, in flowers, and in fruits. They are near the Cunoniaceæ in their capitate flowers, and are also related to the Hamamelidaceæ in fruits.

124 Hamamelidaceæ[4]: Certainly closely related to the Saxifragaceæ and Cunoniaceæ; but, in the anatomy of the wood, the family agrees with the Cunoniaceæ and Bruniaceæ.

125 Eucommiaceæ[5]: Near Trochodendraceæ and Hamamelidaceæ.

126 Platanaceæ[6]: Related to some extent to the Hamamelidaceæ in the form of the styles and stigmata. The family is also connected with the Rosaceæ in the structure of the stem, in the presence of phloroglucin, in the perigynous flowers with perfect apocarpous gynæceum, and especially to the Spiræeæ of the latter family in the receptacle, in the carpels, and in the leaves.

127 Crossosomataceæ[7]: Near the Rosaceæ.

128 Rosaceæ[8]: In floral structure this family bears some resemblance to the Calycanthaceæ and Ranunculaceæ; also to the Combretaceæ, Myrtaceæ, Thymelæaceæ, Leguminosæ, and to the Saxifragaceæ.

129 Connaraceæ[9]: Intimately allied to the Leguminosæ, and also related to some extent to the Anacardiaceæ.

130 Leguminosæ[10]: Bears some affinity to the Rosaceæ, and to the Connaraceæ; also to the Ranunculaceæ.[11]

1) l. c. III.—2, a, p. 96.
2) l. c. III.—2, a, p. 105.
3) Nat. Pfl.-fam. III.—2, a, p. 133.
4) l. c. III.—2, a, p. 120.
5) l. c. Nacht. III. p. 111.
6) l. c. III.—2, a. p. 140.
7) Nat. Pfl.-fam. Nacht. I. p. 185.
8) l. c. III.—3, p. 10.
9) l. c. III.—3, p. 63.
10) l. c. III.—3, p. 99.
11) Mez, C. and Lange, L.—l. c.

Series XXXIII. ***Pandales***

131 Pandaceæ[1]: The relation is not yet very clear.

Series XXXIV. ***Geraniales***

132 Geraniaceæ[2]: Related to the Linaceæ and Rutaceæ, in the number of carpels and ovules.

133 Oxalidaceæ[3]: Intimately allied to the Geraniaceæ. The family is also comparable with the Zygophyllaceæ and Rutaceæ, as shown by DE CANDOLLE.

134 Tropæolaceæ[4]: In floral structure closely connected with the Geraniaceæ and its allies. The family also resembles the Hippocastanaceæ in the oblique position of the gynæceum[5].

135 Linaceæ[6]: Some affinities of this family are found in the Geraniaceæ, Oxalidaceæ and Caryophyllaceæ - Sileneæ; also in the Theaceæ, as can be seen in the many-membered andrœceum of the Hugonieæ (Linac.)

136 Humiriaceæ[7]: Near the Linaceæ.

137 Erythroxylaceæ[8]: BENTHAM-HOOKER and BAILLON put this family beside the Linaceæ; while JUSSIEU, MARTIUS and EICHLER regard it as near akin to the Malpighiaceæ, on account of the structure of the flowers, especially of the 3-celled ovary.

138 Zygophyllaceæ[9]: Near the Rutaceæ.

139 Cneoraceæ[10]: Near the Zygophyllaceæ.

140 Rutaceæ[11]: Related to several families, such as the Burseraceæ, Cneoraceæ and Zygophyllaceæ of the Geraniales, this family is especially allied to the Simarubaceæ, as is seen in the agreement of the Dictyolomeæ (Rutaceæ) and the Simarubaceæ, in the stamens provided with scales at the base. The Flindersieæ of the Rutaceæ are related to the Meliaceæ in the fruit.

141 Simarubaceæ[12]: As above. Intimately allied to the Rutaceæ.

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1) ENGLER, A.—Syllabus l. c. p. 223.
2) Nat. Pfl.-fam. III.—4, p. 7.
3) l. c. III.—4, p. 18.
4) l. c. III.—4, p. 26.
5) BUCHENAU, Fr. — Tropæolaceæ, in das Pflanzenreich IV.—131, p. 10.
6) l. c. III.—4, p. 30.
7) l. c. III.—4, p. 36.
8) l. c. III.—4, p. 39.
9) Nat. Pfl.-fam. III.—4, p. 78.
10) l. c. III.—4, p. 94.
11) l. c. III.—4, p. 108.
12) l. c. III.—4, p. 206.

142 Burseraceæ [1]: In general characters, this family is quite close to the Rutaceæ and Simarubaceæ. But, if we take the presence of the resin-ducts into consideration, we are forced to recognize that the same limited connection exists between the Burseraceæ and the very remotely placed Pinaceæ, as between the latter family and the Anacardiaceæ.

143 Meliaceæ [2]: In the presence of secretory cells, these bear some resemblance to the Sapindaceæ.

144 Malpighiaceæ [3]: Related to the Erythroxylaceæ, also to the Zygophyllaceæ through the intermediate form of *Nitraria* (Zygoph.). Somewhat comparable with the Sapindaceæ in fruit and habit.

145 Trigoniaceæ [4]: Allied to the Polygalaceæ, Euphorbiaceæ, Hippocrateaceæ, Malpigiaceæ, Sapindaceæ and Vochysiaceæ.

146 Vochysiaceæ [5]: This family is placed close to the Polygalaceæ by BENTH.-HOOKER, but it is brought near the Oenotheraceæ by DE CANDOLLE. Also related to the Trigoniaceæ.

147 Tremandraceæ [6]: Near Polygalaceæ, Sterculiaceæ and Pittosporaceæ.

148 Polygalaceæ [7]: Near the Leguminosæ.

149 Dichapetalaceæ [8]: So far as the sympetalous and zygomorphous flowers of some genera of the family are concerned, it should be assigned to the Metachlamydeæ. In other characters, the family shows the closest affinity with the Euphorbiaceæ.

150 Euphorbiaceæ [9]: As regards the structure of the gynæceum and the seeds, this family is, generally speaking, closely related to the families of the Geraniales. An undeniable resemblance is to be seen between the Euphorbiaceæ and the Menispermaceæ [10].

151 Callitrichaceæ [11]: In the structure of fruit and in the presence of

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1) l. c. III.—4, p. 233.
2) Nat. Pfl.-fam. III.—4, p. 266.
3) l. c. III.—4, p. 52.
4) l. c. III.—4, p. 311.
5) l. c. III.—4, p. 315.
6) BENTH.-HOOK. Gen. Plantarum I. p. 134.
7) Nat. Pfl.-fam. III.—4, p. 329.
8) l. c. III.—4, p. 347.
9) l. c. III.—5, p. 13.
10) DIELS, L.—Menispermaceæ, in das Pflanzenreich, IV.—94, p. 41.
11) l. c. III.—5, p. 122.

single integments, the family is somewhat comparable with the sympetalous families. But in other respects, it rather resembles the Euphorbiaceæ.

Series XXXV. ***Sapindales***

152 Buxaceæ[1]: ENDLICHER, MÜLLER of Argau and EICHLER place this family near the Euphorbiaceæ. BENTHAM-HOOKER goes a step further and assigns it to the latter family. BAILLON, however, treats the Buxaceæ as a tribe of the Celastraceæ. Further, it bears some resemblance to the Empetraceæ.

153 Empetraceæ[2]: Comparable with the Euphorbiaceæ and Celastraceæ (EICHLER and ENDLICHER); but certainly assignable to the Sapindales in the structure of flowers and seeds. Also near the Buxaceæ.

154 Coriariaceæ[3]: Closely related to the Empetraceæ.

155 Limnanthaceæ[4]: The family is near the Geraniaceæ, in its habit; but is seen to be related to the Anacardiaceæ, Sapindaceæ and Aceraceæ, when the characters of the ovules are taken into consideration.

156 Anacardiaceæ[5]: In the characters of the seeds, this family is closely related to the Sapindaceæ; while the presence of resin-ducts gives it the same relationship as we have described under the Burseraceæ. It bears some resemblance to the Juglandaceæ and Julianiaceæ.

157 Cyrillaceæ[6]: PLANCHON considering the habit and the peculier anthers of *Costæa* in this family places it near the Ericaceæ. BAILLON makes the Aquifoliaceæ akin to the Cyrillaceæ.

158 Pentaphylacaceæ[7]: The family is related to the Celastraceæ in so far as the absence of stipules, the inflorescence in the campylotropous ovules, and the dehiscence of the fruit are concerned. It is, however, to some extent, comparable with the Clethraceæ, when we lay stress upon the pored anthers and the capsules. It bears on one hand some resemblance to the Theaceæ in habit, while, on the other, it is related to the Coriariaceæ, in the character of the perianth, in the diagram of the flowers, and in the dorsal raphe of the ovules.

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1) Nat. Pfl.-fam. III.—5, p. 131.
2) l. c. III.—5, p. 125.
3) l. c. III.—5, p. 129.
4) l. c. III.—5, p. 136.
5) Nat. Pfl.—fam. III.—5, p. 144.
6) l. c. III.—5, p. 180.
7) l. c. Nacht. I. p. 215, Nacht. III. p. 197.

159 Corynocarpaceæ[1]: Referred to the Berberidaceæ by JUSSIEU and SPRENGEL, while assigned to the Anacardiaceæ by HOOKER. At the same time, the family is compared with the Myrsinaceæ by some authors. ENGLER maintains that it should be referred to the Sapindales, while VAN TIEGHEM places it near the Geraniaceæ.

160 Aquifoliaceæ[2]: Near the Icacinaceæ. Also related to the Celastraceæ in the 'leiterförmige Durchbrechungen.' In habit, the family is so very near the Symplocaceæ, that it is altogether impossible to distinguish one from the other in sterile specimens. This resemblance is not only externally manifest but also internally, as is seen in the anatomical characters[3].

161 Celastraceæ[4]: Closely connected with the Hippocrateaceæ, Sapindaceæ, Staphyleaceæ, Icacinaceæ, Aquifoliaceæ and Rhamnaceæ, the family also bears some resemblance to the Euphorbiaceæ, as can be seen in a comparison of *Elæodendron* (Celastr.) with the Phyllantheæ (Euphorb.)

162 Hippocrateaceæ[5]: The relation of this family to others is as yet undetermined. Somewhat related to the Celastraceæ and Trigoniaceæ.

163 Salvadoraceæ[6]: The general affinity of this family with the Celasatraceæ is incontestable. But, so far as the gamophyllous corolla is concerned, it should be brought quite close to the Oleaceæ.

164 Stackhousiaceæ[7]: Closely related to the Celastraceæ.

165 Staphyleaceæ[8]: These are closely related to the Sapindaceæ in the copious albumen, in the intrastaminal discus, in the straight embryo, and in the anatomical characters. DE CANDOLLE and ENDLICHER place the Staphyleaceæ near the Celastraceæ.

166 Icacinaceæ[9]: Very near the Aquifoliaceæ; but so far as the fruit is concerned, they are quite close to the Olacaceæ.

167 Aceraceæ[10]: Nearest the Sapindaceæ and Hippocastanaceæ.

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1) Nat. Pfl.-fam. Nacht. I. p. 217; Nacht. III. p. 197.
2) l. c. III.-5, p. 185.
3) I am informed of this statement by Dr. R. KANEHIRA.
4) Nat. Pfl.-fam. III.—5, p. 198.
5) l. c.
6) l. c. IV.—2, p. 17.
7) l. c. III.—5, p. 232.
8) l. c. III.—5, p. 259.
9) Nat. Pfl.-fam. III.—5, p. 241.
10) l. c. III.—5, p. 269.

168 Hippocastanaceæ[1]: Very near to the Sapindaceæ and Aceraceæ.

169 Sapindaceæ[2]: Close to the Hippocastanaceæ and Aceraceæ. Further, this family is related on one hand to the Meliaceæ, and on the other to the Anacardiaceæ. Its affinity with the Meliaceæ is to be found in the habit and anatomy, especially in the secretory cells; to the Anacardiaceæ, in the habit, and in the apotropous ovules. Through the Anacardiaceæ, it is connected with the Burseraceæ; through the Meliaceæ, it is allied to the Simarubaceæ and Rutaceæ. Further, it is sometimes compared with the Malpighiaceæ in its winged fruit; also to the Melianthaceæ and Staphyleaceæ by the same fruit character.

170 Sabiaceæ[3]: In the exalbuminous seeds, the curved embryos, the reniform fruit, and the nearly apocarpous ovaries, the Sabiaceæ are compared with the Menispermaceæ by BLUME, MIERS, and HOOKER et THOMSON. But BENTHAM-HOOKER put them close to the Anacardiaceæ and Sabiaceæ.

171 Melianthaceæ[4]: Closely related to the Sapindaceæ, as is seen in the agreement of *Bersama* and *Melianthus*, in the zygomorphous flowers, in the one-sided extra-staminal discus, in the abortion of some corolla-lobes and stamens, and in the apotropous ovules; also to the Staphyleaceæ, in the seeds with copious albumen, in the straight embryo and in the absence of the continuous sclerenchymatous ring. The Balsaminaceæ present some relation with this family in the median symmetry of their flowers, in the spur-like form of one of the sepals and in the deposits of potassium oxalate. RADLKOFER refers to the relation of the Zygophyllaceæ and the Melianthaceæ, as he finds potassium oxalate in *Bersama* and *Melianthus*, which occurs in the same form as in the Zygophyllaceæ, HARVEY and BAILLON, however, compare the family with the Saxifragaceæ.

172 Balsaminaceæ[5]: The only reason for this family being referred to the Sapindales is the position of the micropyles and raphes. On the other hand, in general characters, it is closely related to the families of the Geranials, such as the Malpighiaceæ, Trigoniaceæ, Vochysiaceæ and Tropæolaceæ. Whether it should be assigned to the Sapindales or to the Geraniales depends

1) l. c. III.—5, p. 275.
2) l. c. III.—5, p. 298.
3) Nat. Pfl.-fam. III.—5, p. 369.
4) l. c. III.—5, p. 378.
5) Nat. Pfl.-fam. III.—5, p. 388.

upon the criteria adopted. It is useless asking which is the better or more natural position.

Series XXXVI. ***Rhamnales***

173 Rhamnaceæ[1]: Nearest akin to the Rhamnaceæ are the Vitaceæ; after which come the Celastraceæ. They are also compared with the Oliniaceæ (Myrtifloræ) by BAILLON.

174 Vitaceæ[2]: In floral structure these come quite close to the Rhamnaceæ. Another closely related family which may be pointed out next to the Rhamnaceæ, is that of the Umbelliferæ, perhaps more closely allied to the Vitaceæ, if we put aside the difference in the relative position of petals and stamens.

Series XXXVII. ***Malvales***

175 Elæocarpaceæ[3]: Intimately connected with the Tiliaceæ. The family is also related to the Flacourtiaceæ, as can be seen in a comparison of *Prockia* and *Hasseltia*.[4] It is, therefore, regarded by some authors, as a family intermediate between the Malvales and the Parietales.

176 Chlænaceæ[5]: DE CANDOLLE refers this family to the Malvales. BAILLON places it near the Theaceæ or even assigns it to the latter family. It is nearer to the Tiliaceæ than to the Malvales, in so far as the constant dithecous stamens are concerned. It is also comparable with the Dipterocarpaceæ.

177 Gonystylaceæ[6]: Related to the Tiliaceæ in its anatomical and morphological characters.

178 Tiliaceæ[7]: Connected with the Malvaceæ, Sterculiaceæ and Chlænaceæ of the Malvales. Also with the Theaceæ, Dipterocarpaceæ, Bixaceæ and Flacourtiaceæ of the Parietales.

179 Malvaceæ[8]: These stand quite near the Bombacaceæ, Sterculiaceæ and Tiliaceæ. But, in the hairy seeds, in the curved embryo and in the secondary meristem in the xylem, they are closely related to the Convolvulaceæ.

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1) l. c. III.—5, p. 398.
2) Nat. Pfl.-fam. III—5, p. 439.
3) l. c. III.—6, p. 3.
4) Both genera belong to the Flacourtiaceæ.
5) l. c. III.—6, p. 172.
6) Nat. Pfl.-fam. Nacht. I. p. 232.
7) l. c. III.—5, p. 13.
8) l. c. III.—6, p. 33.

180 Bombacaceæ[1]: Near the Malvaceæ.

181 Sterculiaceæ[2]: Without doubt closely related to the Malvaceæ in general characters. But in the stamens and gynæceum and cocci, they are very like the Euphorbiaceæ.

182 Scytopetalaceæ[3]: PIERRE places this family near the Theaceæ. ENGLER refers it to the Malvales.

Series XXXVIII. *Parietales*

183 Dilleniaceæ[4]: Certainly related closely to the Theaceæ, but in other respects, this family presents some resemblance to the Ranunculaceæ and to the Rosaceæ.

184 Eucryphiaceæ[5]: Somewhat comparable with the Rosaceæ and Saxifragaceæ. Also near the Guttiferæ and Theaceæ.

185 Ochnaceæ[6]: As the family type shows the spiro-cyclical arrangement of the floral elements, it certainly admits of comparison with the Ranunculaceæ (WETT. p. 596). At the same time, it is quite referable to the Parietales.

186 Caryocaraceæ[7]: BENTHAM-HOOKER refers this family to the Ternstrœmiaceæ.

187 Marcgraviaceæ[8]: Related to the Theaceæ.

188 Quiinaceæ[9]: Close to the Ochnaceæ and Theaceæ, this family in habit and in the hairy seeds, also bears some resemblance to the Cunoniaceæ.

189 Theaceæ[10]: These are connected with the Chlænaceæ through the Asteropeieæ, and with the Marcgraviaceæ through the Pelliciereæ. At the same time, they are related to the Dilleniaceæ on one hand, and to the Guttiferæ and Dipterocarpaceæ on the other. Also they admit of comparison with the Metachlamydeæ, as some genera such as *Anneslea* show the gamopetalous corolla.

190 Guttiferæ[11]: Certainly related to the Theaceæ, these come near

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1) l. c. III.—6, p. 57.
2) l. c. III.—6, p. 73.
3) Nat. Pfl.-fam. Nacht. I. p. 244.
4) l. c. III.—6, p. 108.
5) l. c. III.—6, p. 131.
6) l. c. III.—6, p. 138.
7) Nat. Pfl.-fam. III.—6, p. 156.
8) l. c. III.—6, p. 161.
9) l. c. III.—6, p. 166.
10) l. c. III.—6, p. 179.
11) l. c. III.—6, p. 204.

the Dipterocarpaceæ in the schizogenous resin-ducts. They resemble the Ebenaceæ in their fruit.

191 Dipterocarpaceæ[1]: Related to the Guttiferæ in the resin-ducts, the family is also comparable to some extent with the Theaceæ, Ochnaceæ and Tiliaceæ. In the presence of a ring of secretory canals in the medulla-crown, it resembles the Cornaceæ, Simarubaceæ and Hamamelidaceæ.

192 Elatinaceæ[2]: DE CANDOLLE assigns this family to his Caryophylleæ; BARTLING joins it to the Lythraceæ; while BRONGNIART and A. BROWN place it near the Crassulaceæ. Recently, it has been brought near the Tamaricaceæ and Frankeniaceæ with which the Elatinaceæ show similar receptacles and ovaries, and bilamellate placentas.

193 Frankeniaceæ[3]: This family is allied to the Guttiferæ in the habit, in the andrœceum and in the gynæceum (mostly trimerous). But, it is closaly related to the Tamaricaceæ, and is also comparable with the Caryophyllaceæ.

194 Tamaricaceæ[4]: This family is certainly comparable with the Frankeniaceæ and Elatinaceæ. But, when we consider the gynæceum, placenta, ovules, seeds, and fruit and even the perforation of vessels and other anatomical characters, we are forced to conclude that the Tamaricaceæ are without doubt related to the Salicaceæ.

195 Fouquieriaceæ[5]: These are unquestionablly related to the Polemoniaceæ, in the 3-celled ovary, in the more or less connate styles, and in the tube-like corolla with stamens at its base. In other respects, they are quite close to the Tamaricaceæ.

196 Cistaceæ[6]: Near the Bixaceæ and Violaceæ.

197 Bixaceæ[7]: VAN TIEGHEM refers this family to the Malvales. ENGLER places it in the Parietales. The latter opinion is explained by the resemblance of the Bixaceæ and Flacourtiaceæ, while the former is substantiated by the agreement of the Bixaceæ and Tiliaceæ in the mucilage canals in the medulla, cortex, and leaves; in the loculicidal dehiscence of the fruit; in the hairy

1) l. c. III.—6, p. 252.
2) l. c. III.—6, p. 279.
3) l. c. III.—6, p. 286.
4) Nat. Pfl.-fam. III.—6, p. 291.
5) l. c. Nacht. I. pp. 251 and 368; Nacht. III. p. 228.
6) Nat. Pfl.-fam. III.—6, p. 302.
7) l. c. III.—6, p. 309; Nachtr. III. p. 231.

covering of the seeds; in the flat cotyledons imbedded in the albumen; in the palmate nerves of the leaves; in the basal connation of the stamens; in the pored anthers; and in the absence of septa in the substitute fibres.

198 Cochlospermaceæ[1]: Near the Bixaceæ. VAN TIEGHEM refers this family to the Malvales.

199 Winteranaceæ[2]: So far as the presence of oil cells in the cortex, medulla and leaves, the bordered pits in the wood-prosenchyma, the general structure of the xylem and the inconstant number and spiral arrangement of the perianth-segments are concerned, this family comes very close to the Magnoliaceæ. But when we take into consideration the presence of oil-cells placed as above mentioned and the connation of the stamens, it should be brought near the Myristicaceæ. In other general characters, however, it is rather related to the Violaceæ and Flacourtiaceæ.

200 Violaceæ[3]: Near the Flacourtiaceæ and Cistaceæ.

201 Flacourtiaceæ[4]: Closely related to the Violaceæ, Turneraceæ, Bixaceæ, Tiliaceæ and Passifloraceæ. The family also comes near the Stachyuraceæ, Cistaceæ, Theaceæ and Elæocarpaceæ. In some respects, the family is a transitional form between the Datiscaceæ and the Caricaceæ. Further, it is comparable with the Capparidaceæ.

202 Stachyuraceæ[5]: This family is clearly related to the Dilleniaceæ and to the Theaceæ. BAILLON points out its relation to the Clethraceæ and to the Bixaceæ.

203 Turneraceæ[6]: Near the Passifloraceæ and Malesherbiaceæ.

204 Malesherbiaceæ[7]: Close to the Passifloraceæ and Turneraceæ.

205 Passifloraceæ[8]: Intimately allied to the Malesherbiaceæ, and Turneraceæ in general respects. But in the receptacles and their effigurations and in the often stalked ovaries, the family is comparable with the Thymelæaceæ. In some other respects, it is rather close to the Cucurbitaceæ.

206 Achariaceæ[9]: In the superior ovaries, in the parietal placentas

1) l. c. Nachtr. III. p. 231.
2) l. c. III.—6, p. 316.
3) Nat. Pfl.-fam. III.—6, p. 327.
4) l. c. III.—6, a, p. 10.
5) Nat. Pfl.-fam. III.—6, p. 193.
6) l. c. III.—6, a, p. 60.
7) l. c. III.—6, a, p. 68.
8) l. c. III.—6, a, p. 78.
9) Nat. Pfl.-fam. Nachtr. I. p. 257.

and in the presence of albumen, it is very near the Passifloraceæ; but in the gamophyllous corolla, it approaches the Cucurbitaceæ.

207 Caricaceæ[1]: In the structure of their ovaries, the Caricaceæ are closely related to the Passifloraceæ; but in the structure of the ovules, they are related to the Cucurbitaceæ (VAN TIEGHEM).

208 Loasaceæ[2]: DE CANDOLLE refers this family to the Calycifloræ on account of the rudiments of the stamens, and places it near the Oenotheraceæ and Portulacaceæ; at the same time, he gives as the near kin of the Loasaceæ the Passifloraceæ and Turneraceæ on one side, and the Papaveraceæ and Cucurbitaceæ on the other. BENTHAM-HOOKER regard the Loasaceæ as a relation of the Begoniaceæ, Cucurbitaceæ and Dipsacaceæ, while EICHLER finds in the Loasaceæ a type midway between the Passifloraceæ and the Myrtifloræ. LINDLEY, however, affirms its relation to the Cactaceæ. It is also near the Turneraceæ. At any rate, it cannot be denied that there exist many points of resemblance between the Loasaceæ and the Begoniaceæ, especially in the structure of the seeds.

209 Datiscaceæ[3]: This family was at one time placed close to the Saxifragaceæ, but at another, near the Cucurbitaceæ. BAILLON regards it as a transitional form between the Piperaceæ and the Urticaceæ. LINDLEY, and BENTH.-HOOKER put the Datiscaceæ near the Begoniaceæ, while DE CANDOLLE brings the family close to the Loasaceæ. Its intimate relation to the Begoniaceæ is particularly referred to in the following lines.

210 Begoniaceæ[4]: These are closely connected with the Datiscaceæ, as can be seen in the inferior ovary, in the manner of the dehiscence of the fruit and in the shape and structure of the seeds and seedlings. On the other hand, the intimate relation between the Begoniaceæ and the Cucurbitaceæ is incontestable, as both families agree perfectly in the unisexual flowers, in the inferior ovaries, in the connate stamens, in the cystolith, in the shape and nerves of the leaves, in the placentas, and in the seeds. The Saxifragaceæ may be regarded as kin of the Begoniaceæ, as the two families agree in the

1) l. c. III.—6, a, p. 98; Nachtr. III. p. 235.
2) l. c. III.—6, a, p. 106.
3) Nat. Pfl.-fam. III.—6, a, p. 152.
4) Nat. Pfl.-fam. III.—6, a, p. 133.

parietal placentas, in the small seeds, in the dehiscence of the fruit and in the leaf-shape.

211 Ancistrocladaceæ[1]: This family is somewhat related to the Combretaceæ, Malpighiaceæ, Symplocaceæ, Myristicaceæ and Anonaceæ in one point or another. PLANCHON places it near the Dipterocarpaceæ, while BENTHAM-HOOKER and BAILLON go a step further and even assign it to that family.

Series XXXIX. ***Opuntiales***

212 Cactaceæ[2]: Related to the Aizoaceæ, as can be seen in the floral diagrams of *Mesembrianthemum* and *Opuntia*.

Series XL. ***Myrtifloræ***

213 Geissolomataceæ[3]: BAILLON refers this family to the Celastraceæ. BENTHAM-HOOKER assigns it to the Penæaceæ. DE CANDOLLE on the other hand regards it as a distinct family and places it near the Penæaceæ.

214 Penæaceæ[4]: Very close to the Thymelæaceæ.

215 Oliniaceæ[5]: BENTH.-HOOKER assigns this family, though with some hesitation, to the Lythraceæ. BAILLON insists on its being referable to the Rhamnaceæ. GILG retains it as a distinct family and refers it to the Thymelæales, placing it next to the Penæaceæ.

216 Thymelæaceæ[6]: In the receptacles and their effiguration and in the often stalked ovaries, this family is comparable with the Passifloraceæ. But in other respects, it is very close to the Combretaceæ and Lythraceæ. In the cyclical structure of the flowers, in the symcarpous gynæceum, and in the absence of albumen, it comes near the Lauraceæ.

217 Elæagnaceæ[7]: Near the Thymelæaceæ, in the floral structure, especially in the receptacles and fruit. BAILLON places this family between the Lauraceæ and the Myristicaceæ.

218 Lythraceæ[8]: This comes near the Myrtaceæ and Onagraceæ, and

1) l. c. III.—6, p. 276.
2) WETTSTEIN, R. R.—l. c. p. 533.
3) l. c. III.—6, a, p. 206.
4) l. c. III.—6, a, p. 210.
5) l. c. III.—6, a, p. 215.
6) Nat. Pfl.-fam. III.—6, a, p. 221.
7) l. c. III.—6, a, p. 248.
8) l. c. III.—7, p. 6; KŒHNE, E.—Lythraceæ, in das Pflanzenreich IV.—216. p. 21.

is also related to the Punicaceæ, Blattiaceæ and to the Combretaceæ.

219 Sonneratiaceæ[1] (=Blattiaceæ): Near the Lythraceæ in morphological and anatomical characters. It is also close to the Punicaceæ.

220 Punicaceæ[2]: Closely related to the Lythraceæ in the valvate calyx, in the imbricate wrinkled petals, in the stamens and in the anatomy of the stem. Also to the Sonneratiaceæ in the ovary partly connate to the receptacles, and in the 4-winged young stems.

221 Lecythidaceæ[3]: Intimately connected with the Myrtaceæ. But the family comes near the Sonneratiaceæ through *Fœtidia* (Lecythid.) on one hand, while on the other, it is allied to the Rhizophoraceæ through *Barringtonia* (Lecythid.) The latter genus is referred to the Myrtaceæ in my general index.

222 Rhizophoraceæ[4]: This family is kin to the Combretaceæ and Lythraceæ. It is related to the former family by the Anisophylloideæ (Rhizoph.), in the locular ovary and in the stout hypocotyle; to the latter family by the Macarisieæ (Rhizoph.) with free ovaries.

223 Nyssaceæ[5]: Related to the Combretaceæ in the one-celled ovary, and in the diplostemonous andrœceum.

224 Alangiaceæ[6]: These approach *Polyosma* which is referable to the Saxifragaceæ, in the general construction of its flowers.

225 Combretaceæ[7]: Related to the Rhizophoraceæ, Myrtaceæ and Onagraceæ.

226 Myrtaceæ[8]: To be mentioned as akin to the Lythraceæ and Sonneratiaceæ by the Metrosiderinæ; and to the Lecythidaceæ by the Myrtinæ.

227 Melastomataceæ[9]: In habit, in floral structure, and in the anatomy of the stem, this family is closely related to the Myrtaceæ and to the Lythraceæ, when especially the genera of the Melastomataceæ with pinnati-nerved leaves and reduced appendages of the connectives are considered. In the displacement of the placenta, and in the course of development of the ovary, it is

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1) Nat. Pfl.-fam. III.—7, p. 18.
2) l. c. III.—7, p. 25.
3) l. c. III.—7, p. 29.
4) l. c. III.—7, p. 49.
5) WANGERIN, W.—Nyssaceæ, in das Pflanzenreich, IV.—220, a, p. 7.
6) WANGERIN, W.—Alangiaceæ, in das Pflanzenreich, IV.—220, b, p. 6.
7) l. c. III.—7, p. 113.
8) l. c. III.—7, p. 62.
9) l. c. III.—7, p. 142.

somewhat comparable with the Punicaceæ. The Lythraceæ come near the Melastomataceæ in the tube-like receptacles.

228 Oenotheraceæ[1] (=Onagraceæ): Related to the Lythraceæ; also to the Halorrhagaceæ, by the Trapeæ.

229 Halorrhagaceæ[2]: Intimately related to the Oenotheraceæ in the floral structure, and in the anatomy of the stems. Moreover, the family is somewhat comparable with the Chloranthaceæ in the reduced form of *Hippuris*. It also bears some resemblance to the Callitrichaceæ. In respect of the endosperms, the family approaches the Umbelliforæ, especially the Cornaceæ[3].

230 Hippuridaceæ[4]: The relation of this group is mentioned in the preceding family. Near Oenotheraceæ and Chloranthaceæ.

231 Cynomoriaceæ[5]: Near the Halorrhagaceæ.

Series XLI. *Umbelliforæ*

232 Araliaceæ[6]: Very near the Umbelliferæ. The numerous stamens and carpels in some of the Araliaceæ clearly show the intimate relation between the family and the Myrtaceæ.

233 Umbelliferæ[7]: Quite close to the Araliaceæ and the Cornaceæ. In other respects, the intimate relation of the family to the Rubiaceæ is boyond question. It is also clearly connected with the Vitaceæ through the Araliaceæ.

234 Cornaceæ[8]: On the one hand this family is allied to Caprifoliaceæ by *Cornus*, while on the other, it is connected with the Araliaceæ by *Mastixia*, *Davidia*, and *Curtisia*. All of the Corneæ are related to the Caprifoliaceæ in certain characters; but in other characters, to the Araliaceæ.

Subclass **Metachlamydeæ**

Several families of this subclass are respectively connected with the Cornaceæ, Dichapetalaceæ, Theaceæ, Callitrichaceæ and Aristolochiaceæ of the subclass Archichlamydeæ.

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1) Nat. Pfl.-fam. III.—7, p. 204.
2) l. c. III.—7, p. 230.
3) Schindler, A. K.—Halorrhagaceæ IV.—225, p. 15.
4) l. c. Nachtr. III. p. 250.
5) Nat. Pfl.-fam. III.—1, p. 249, and Nachtr. I. pp. 149–150, and p. 268.
6) l. c. III.—8, p. 15.
7) Nat. Pfl.-fam. III.—8, p. 110.
8) l. c. III.—8, p. 254.

Series XLII. *Ericales*

235 Clethraceæ[1]: Close relations are to be found in the Ericaceæ and in the Ternstrœmiaceæ; but in other respects, it is closely allied to the Stachyuraceæ and Pentaphylacaceæ.

236 Pirolaceæ[2]: Intimately related to the Ericaceæ.

237 Lennoaceæ[3]: Connected with the Ericaceæ and Pirolaceæ.

238 Ericaceæ[4]: Certainly referable to the Metachlamydeæ; but, when special attention is given to the stamens sitting not on the corolla but on the disk, one is convinced that there exists an intimate connection between the Ericaceæ and choripetalous families. But in the more or less united stamens which are present in some genera of the Ericaceæ, the family is related to the Campanulaceæ.

239 Epacridaceæ[5]: Near the Ericaceæ.

240 Diapensiaceæ[6]: Near the Clethraceæ, Pirolaceæ and Ericaceæ; and also near the Epacridaceæ in the insertion of stamens on the corolla. Another relation exists between the Diapensiaceæ and the Primulaceæ, as can be seen in a comparison of *Schizocodon* and *Soldanella*. The family is more or less connected with the Polemoniaceæ, Loganiaceæ and Verbenaceæ-Stilbeæ.

Series XLIII. *Primulales*

241 Theophrastaceæ[7]: Approaches the Myrsinaceæ, Primulaceæ and Sapotaceæ.

242 Myrsinaceæ[8]: The connection of this family with the Primulaceæ is so close that to separate the one from the other is entirely artificial. The family also approaches the Sapotaceæ in the floral diagram, but in other respects, it comes near the Corynocarpaceæ.

243 Primulaceæ[9]: Related to the Myrsinaceæ, Plumbaginaceæ and to the Diapensiaceæ.

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1) Nat. Pfl.-fam. IV.—1, p. 2.
2) l. c. IV.—1, p. 7.
3) l. c. IV.—1, p. 14.
4) l. c. IV.—1, p. 30.
5) Nat. Pfl.-fam. IV.—1, p. 71.
6) l. c. IV.—1, p. 81.
7) l. c. Nachtr. III. p. 268.
8) l. c. IV.—1, p. 87; Mez, C.—Myrsinaceæ, in das Pflanzenreich, IV.—236, p. 12.
9) Nat. Pfl.-fam. IV.—1, p. 104; Pax, F. und Knuth, R.—Primulaceæ, in das Pflanzenreich, IV.—237, p. 15.

Series XLIV. ***Plumbaginales***

244 Plumbaginaceæ[1]: Near the Primulaceæ and Myrsinaceæ as can be seen in the diagram of flowers, in the one-celled ovary consisting of 5-carpels with a basal placenta and in the double-coated ovules. Many place this family near the Polygonaceæ.

Series XLV. ***Ebenales***

245 Sapotaceæ[2]: Comparable with the Myrsinaceæ and the Ebenaceæ; also with the Styracaceæ in the floral structure.

246 Ebenaceæ[3]: Closely allied to the Styracaceæ, Symplocaceæ and Sapotaceæ. Also comparable with the Anonaceæ in the rimose albumen of the seeds and in the trimerous flowers. The family approaches the Guttiferæ in the fruit.

247 Symplocaceæ[4]: Certainly related to the Styracaceæ, Ebenaceæ and Sapotaceæ in general characters, but in some respects, the family is connected with the Ancistrocladaceæ. In external and anatomical features, it is very near the Aquifoliaceæ.

248 Styracaceæ[5]: Closely related to the Symplocaceæ, Sapotaceæ and Ebenaceæ.

Series XLVI. ***Contortæ***

249 Oleaceæ[6]: Undoubtedly allied to the Loganiaceæ and the Rubiaceæ; but in other characters, comparable with the Celastraceæ and Salvadoraceæ.

250 Loganiaceæ[7]: This is a very heterogeneous family, the genera of which are related respectively to the Asclepiadaceæ, Apocynaceæ, Gentianaceæ, Solanaceæ, Rubiaceæ, and Scrophulariaceæ. Baillon holds the view that the family should be disorganized and its genera should be referred respectively to the different families above mentioned.

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1) l. c. IV.—1, p. 121; Nachtr. III. p. 287.
2) l. c. IV.—1, p. 130.
3) l. c. IV.—1, p. 156.
4) Nat. Pfl.-fam. IV.—1, p. 168.
5) l. c. IV.—1, p. 175.
6) l. c. IV.—2, p. 4.
7) l. c. IV.—2, p. 26.

251 Gentianaceæ[1]: Intimately connected with the Loganiaceæ.

252 Apocynaceæ[2]: Closely related to the Asclepiadaceæ. The family is allied to the Gentianaceæ and Rubiaceæ in the inferior ovary and in the stipules; and to the Loganiaceæ in the bicollateral bundles; and is especially close to the woody genera of the latter family in the decussate opposite leaves, in the reduced stipules, in the æstivation of the corolla, in the insertion of the stamens, and in the structure of the ovary.

253 Asclepiadaceæ[3]: Very closely related to the Apocynaceæ.

Series XLVII. ***Tubifloræ***

254 Convolvulaceæ[4]: In some particular characters, to which we have already referred, this family is undoubtedly connected with the Malvaceæ. It is also related to the Borraginaceæ, Hydrophyllaceæ and Polemoniaceæ in the æstivation of the corolla, in the inflorescence and in the trimerous ovary; to the Solanaceæ in the presence of inner phloëm in the vascular bundles, in the dimerous ovary, and in the berry-like fruit (which occurs in *Erycibe* and *Argyreia* of the Convolvulaceæ); to the Verbenaceæ and to the Acanthaceæ, in the regular flowers, and in the definite number of the ovules.

255 Polemoniaceæ[5]: Very closely related to the Convolvulaceæ. But, in the 3-celled ovary, in the more or less connate styles, in the tubiform corollawith stamens attached slightly at its base, the family is very near the Fouquieraceæ.

256 Hydrophyllaceæ[6]: Near the Gentianaceæ, Borraginaceæ, and Scrophulariaceæ (Benth.-Hook. Gen. Plant. II. p. 825).

257 Borraginaceæ[7]: This family somewhat agrees with the Hydrophyllaceæ in the ovules, in the inflorescence, and in the hairy leaves. On the other hand, it is closely related to the Verbenaceæ and to the Labiatæ in having eremi. The Cordioideæ of the Borraginaceæ are connected with the Convolvulaceæ in the folded cotyledons.

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1) Nat. Pfl.-fam. IV.—2, p. 60.
2) l. c. IV.—2, p. 118.
3) l. c. IV.—2, p. 204.
4) Nat. Pfl.-fam. IV.—3, a, p. 11.
5) l. c. IV.—3, a, p. 44.
6) Nat. Pfl.-fam. IV.—3, a, p. 59.
7) l. c. IV.—3, a, p. 80.

258 Verbenaceæ[1]: Related to the Scrophulariaceæ, Phrymaceæ and Convolvulaceæ. The borraginaceous genera with the terminal styles and actinomorphous flowers are very much like the Verbenaceæ. The Solanaceæ with few ovules are closely connected with the Verbenaceæ.

259 Labiatæ[2]: The relation of this family to the Borraginaceæ is seen in the eremus-formation. It is also connected with the Scrophulariaceæ, Acanthaceæ and Verbenaceæ. BAILLON points out that the Borraginaceæ imply plants with terminal styles as well as those with gynobasic ones, while the Labiatæ and Verbenaceæ are each made a family, by the fact of its having terminal styles or gynobasic ones. Such a classification is altogether inconsistent. In any case, the separation of the latter two families is purely subjective[3].

260 Nolanaceæ[4]: This family is undeniably related to the Convolvulaceæ, Borraginaceæ, and Solanaceæ. Its connection with the Convolvulaceæ is to be found in the corolla, and in the 3–5-carpelled ovary. Its resemblance to the Borraginaceæ exists in the peculiar fruit-formation. It is most closely related to the Solanaceæ in the æstivation of the corolla, in the ramification of the stems, in the foliar arrangement, and in the structure of the seeds.

261 Solanaceæ[5]: Morphologically speaking, this is a very heterogeneous family. It includes several forms transitional between the families of the Tubifloræ with actinomorphous flowers and those with zygomorphous flowers. The Solaneæ and Nicandreæ with regular flowers approach the families of the former category; while the Cestreæ and Salpiglossideæ pass so gradually into the Scrophulariaceæ (a family of the latter category), that it is quite artificial to draw a line between these tribes of the Solanaceæ and the Scrophulariaceæ. A revision of the genera of the Solanaceæ shows us clearly that these genera bear close relations to several different families respectively.

262 Scrophulariaceæ[6]: This has such close relations to many other families that it is rather a difficult task to limit the family. The Scrophularia-

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1) l. c. IV.—3, a, p. 143.
2) l. c. IV.—3, a, p. 205.
3) *Amethystea cærulea* LINN. may be just as well assigned to the Verbenaceæ, as to the Labiatæ.
4) Nat. Pfl.-fam. IV.—3, b, p. 2.
5) Nat. Pfl.-fam. IV.—3, b, p. 9.
6) l. c. IV.—3, b, p. 48.

ceæ are nearest to the Solanaceæ, the transitional groups being the Verbasceæ on the side of the formerand the Salpiglossideæ on the part of the latter family. is also close to the Bignoniaceæ, Globulariaceæ and Pedaliaceæ. A strong It tendency towards the Gesneriaceæ is shown in the Gratioleæ of the Scrophulariaceæ. It also bears some resemblance in habit to the Acanthaceæ, Verbenaceæ, and Loganiaceæ. Also the Lentibulariaceæ may be considered to be kin of the Scrophulariaceæ, as can be clearly seen in *Limosella aquatica* L. which is in my opinion assignable rather to the former family, but is, at present, referred to the latter.

263 Bignoniaceæ[1]: In one respect, this family is somewhat comparable with the Scrophulariaceæ, but in another, it is related to the Moringaceæ.

264 Pedaliaceæ[2]: Closely connected with the Scrophulariaceæ, Martyniaceæ, Gesneriaceæ and Bignoniaceæ.

265 Martyniaceæ[3]: Related to the Pedaliaceæ and Gesneriaceæ.

266 Orobanchaceæ[4]: Near the Gesneriaceæ and Scrophulariaceæ.

267 Gesneriaceæ[5]: So intricately connected with the Scrophulariaceæ, Orobanchaceæ and Bignoniaceæ, that it is difficult to draw a line between any two of them.

268 Columelliaceæ[6]: In its opposite leaves, its patent rotate and nearly actinomorphous corolla with a very short tube, its small distinct disc, its 2-valved capsule, and in its numerous seeds with albumen, this family is closely related to the Gesneriaceæ. But in some characters, it bears a relationship to the Oleaceæ, while in others, it is allied to the Cucurbitaceæ.

269 Lentibulariaceæ[7]: This family was at one time placed close to the Primulaceæ, but at another, near the Scrophulariaceæ. With the latter family, it agrees in the haplostemonous flowers, in the 2-lipped corolla with a spur and a palate, in the reduction of the andrœceum to 2-stamens, in the middle position of the 2-carpels and in the dehiscence of the capsules. With the former, it is connected in the central placenta.

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1) Nat. Pfl.-fam. IV.—3, b, p. 209.
2) l. c. IV.—3, b, p. 259.
3) Nat. Pfl.-fam. IV.—3, b, p. 268.
4) l. c. IV.—3, b, p. 128.
5) l. c. IV.—3, b, p. 141.
6) l. c. IV.—3, b, p. 187.
7) l. c. IV.—3, b, p. 117.

270 Globulariaceæ[1]: Undoubtedly related to the Scrophulariaceæ and somewhat comparable with the Myoporaceæ. Also related to several other families — i. e. to the Plumbaginaceæ, in the presence of calcareous scales on the leaves, to the Dipsacaceæ in the inflorescence and fruit, and finally to the Plantaginaceæ in habit.

271 Acanthaceæ[2]: A close connection is found to exist between this family and the Bignoniaceæ. The Acanthaceæ are related to the Scrophulariaceæ, through the Nelsonioideæ (Acanthaceæ) which show an agreement with the Scrophulariaceæ in habit and in the numerous seeds.

272 Myoporaceæ[3]: As close kin of the Myoporaceæ stand, on one side, the Scrophulariaceæ, and on the other, the Verbenaceæ. To the former, they are related through *Myoporum*, *Pholidia*, *Bontia*, and *Zombiana*, in the structure of the corolla and anthers, in the reduced ovules, and in the position and structure of the latter. With the latter, their connection is to be found in *Oftia* (Myop.). The inter-relation of the three families is so close and involved that it may be both right and wrong to leave the Myoporaceæ where they are, or to break up the family, putting some of the genera into the Scrophulariaceæ, and referring the rest to the Verbenaceæ. They also stand near the Cordioideæ of the Borraginaceæ, and to the Solanaceæ, in the structure of the fruit. Finally, they are somewhat comparable with the Oleaceæ, and with the Sesameæ of the Pedaliaceæ.

273 Phrymaceæ[4]: Closely related to the Verbenaceæ in habit and inflorescence; also to the Scrophulariaceæ and Myoporaceæ in the erect ovules.

Series XLVIII. ***Plantaginales***

274 Plantaginaceæ[5]: Döll and Eichler regard this family as a reduced form of the Labiatifloræ, this opinion being supported by the theoretical explanation of the floral diagram and by the 2-celled ovary. The family is also related to the Campanulaceæ through *Phyteuma* (Campanul.). It comes rather near the Goodeniaceæ and Candolleaceæ; while in the absence of laticiferous

1) Nat. Pfl.-fam. IV.—3, b, p. 271.
2) l. c. IV.—3, b, p. 286.
3) Nat. Pfl.-fam. IV.—3, b, p. 357.
4) Nat. Pfl.-fam. IV.—3, b, p. 362.
5) l. c. IV.—3, b, p. 369.

vessels, in the hairy covering, and in the structure of the stomata, it shows its relations to the Labiatæ. BAILLON places this family near the Solanaceæ.

Series XLIX. *Rubiales*

275 Rubiaceæ[1]: Certainly closely related to the Caprifoliaceæ and also to the Valerianaceæ, Dipsacaceæ and Compositæ. But in the cruciate opposite leaves, in the capitate inflorescence, and in the floral structure, this family is closely allied to the Cornaceæ; some of the Rubiaceæ are very near some of the Umbelliferæ in the structure of the fruit. In some particular cases, it shows some connection with the Loganiaceæ and Bignoniaceæ.

276 Caprifoliaceæ[2]: Intimately allied to the Rubiaceæ; also very near the Cornaceæ and to the Valerianaceæ.

277 Adoxaceæ[3]: Somewhat comparable with the Araliaceæ and Saxifragaceæ. Also with the Caprifoliaceæ.

278 Valerianaceæ[4]: Very near the Dipsacaceæ and the Caprifoliaceæ.

279 Dipsacaceæ[5]: Undoubtedly related to the Valerianaceæ, especially to *Triplostegia* of the latter family. BAILLON points out the existence of some resemblance between this family and the Calyceraceæ.

Series L. *Cucurbitales*

280 Cucurbitaceæ[6]: Near the Passifloraceæ, Caricaceæ, Campanulaceæ, Loasaceæ and Begoniaceæ, as has been explained above.

Series LI. *Campanulatæ*

281 Campanulaceæ[7]: This family is related to the Goodeniaceæ and Candolleaceæ through the Lobelioideæ. It also comes close to the Compositæ in the connation of the anthers, in the isostemony, in the nearly (with exceptions) epigynous insertion and in the valvate æstivation of the corolla-lobes. The inflorescence of many campanulaceous genera is similar to that of the

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1) l. c. IV.—4, p. 13.
2) Nat. Pfl.-fam. IV.—4, p. 160.
3) l. c. IV.—4, p. 171.
4) l. c. IV.—4, p. 175.
5) l. c. IV.—4, p. 187.
6) Nat. Pfl.-fam. IV.—5, p. 8.
7) l. c. IV.—5, p. 47.

compositous ones. The presence of inulin is not without significance in explaining the kinship of the two families. The Cichorioideæ, a subfamily of the Compositæ, has articulated laticiferous vessels like those of the Campanulaceæ. As to the relation between the Campanulaceæ and the Cucurbitaceæ, there are many points worthy of mention. The typical epigynous pentamerous flowers, the frequent occurrence of the gamophyllous corolla, the tendency of the stamens to grow together and the calyx with narrow leaf-like lobes, and finally the haplostemonous andrœceum, all suggest the close affinity of the two families.

282 Goodeniaceæ[1]: Very near the Campanulaceæ. Moreover, it resembles the Gentianaceæ, as is seen in a comparison of *Velleia* (Gooden.) with *Limnanthemum* (Gent.)

283 Brunoniaceæ[2]: Near the Goodeniaceæ and Plumbaginaceæ.

284 Stylidiaceæ[3] (=Candolleaceæ): Related to the Campanulaceæ. It is somewhat related to the Cucurbitaceæ in the staminal column with extrorse anthers[4].

285 Calyceraceæ[5]: Near the Compositæ.

286 Compositæ[6]: Related to the Campanulaceæ.

1) Nat. Pfl.-fam. IV.—5, p. 74.
2) ENGLER, A.—Syllabus, l. c. p. 341.
3) l. c. IV.—5, p. 82.
4) MILDBRÆD, J.—Stylidiaceæ, in das Pflanzenreich, IV.—278, p. 15.
5) l. c. IV.—5, p. 86.
6) Nat. Pfl.-fam. IV.—5, p. 116.

11. Index to the Dynamic System.

N.B. The numbers printed in blacker type refer to the headings under which the series or families occur; the numbers printed in Roman type refer to the pages.

GENERAL INDEX

to the

series, from the first volume to the tenth, and also to the studies published by the author while he was preparing this work on Icones.

Orders in CAPITALS; *genera in* **condensed type**; *species in* roman type; *synonyms and species incidentally mentioned in italics.*

ABBREVIATIONS.

B. M. = The Botanical Magazine (Tōkyō) (1904–1910).
E. P. = Enumeratio Plantarum Formosanarum, in Journ. Coll. Sci. Imp. Univ. Tôkyō, Jap. Vol. XXII. (1906).
F. M. = Flora Montana Formosæ, in Journ. Coll. Sci. Imp. Univ. Tōkyō, Jap. Vol. XXV. Art.-19, (1908).
M. F. = Materials for a Flora of Formosa, in Journ. Coll. Sci. Imp. Univ. Tōkyō, Jap. Vol. XXX. Art.-1, (1911).
I. = Icones Plantarum Formosanarum I. (1911).
II. = l.c. II. (1912). V. = l.c. V. (1915). VIII. = l.c. VIII. (1919).
III. = l.c. III. (1913). VI. = l.c. VI. (1916). IX. = l.c. IX. (1920).
IV. = l.c. IV. (1914). VII. = l.c. VII. (1918). X. = l.c. X. (1921).
G. I. = General Index to the Flora of Formosa, Supplement to Ic. Pl. Formos. VI.

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